Distr.
GENERAL

UNCTAD/SDD/SER/6
6 March 1996

ENGLISH ONLY

United Nations Conference on Trade and Development

SERVICES AND THE ENVIRONMENT

A report prepared for the UNCTAD secretariat by Paolo Bifani

TABLE OF CONTENTS

Chapter		Paragraphs
I.	INTRODUCTION	1 - 5
II.	UNDERLYING ISSUES OF THE ENVIRONMENTAL PROBLEMATIQUE	6 - 35
III.	ENVIRONMENTAL SERVICES	36 - 57
IV.	THE ENVIRONMENTAL SERVICES SECTOR	58 - 185
V.	ENVIRONMENTAL SERVICES IN DEVELOPING COUNTRIES	186 - 243
VI.	CONCLUSIONS	244 - 248

The views expressed in this study are those of the author and do not necessarily reflect those of the UNCTAD secretariat.

GE.96-50580

I. INTRODUCTION

1. As the environment becomes increasingly integrated into business conduct, a new breed of environmental professionals and services has appeared. Environmental pressure is being exerted on corporations and local and national governments by both consumers and investors.[1] Environmental degradation has negative effects on production, on the economy as a whole and finally on development. In OECD countries, industrial pollution is the cause of an effective loss of economic output equivalent to 5% of GDP. Moreover, any postponement of corrective action into the future is likely to result in much higher costs than today.

2. The environment has become a crucial determinant of production and consumption, leading to pressure for the implementation and strengthening of environmental management.

3. Environmental management and the fulfillment of environmental regulations requires specific knowledge and technologies. Frequently demanded services concern methodologies, practices, routine processes, environmental managerial skills, data and the technologies for their processing. Some of these services require skilled human resources able to integrate the knowledge pertaining to different disciplines and their translation into practical tools, methods and services. Other services depend upon the availability of specific technologies to undertake a specific process-decontamination, waste-water treatment, land recuperation, re-use and recycling, emission and waste minimization, etc. for the control of processes or for the measurement of environmental parameters and the associated know-how.

4. The supply of environment-related services is based on an expanding gamut of "soft" and "hard" technologies, many of them still not well developed. The environmental problematique has opened a new area for the production of environmental technologies and equipment which is in fact already an important and continuously expanding industrial sector responsible for the production of environmental "hard" technology. An understanding of the nature of these technological developments and of their relevance for the service sector is crucial.

5. The importance of the environment and the growing demand for environment-related services require efforts to identify, assess and analyze a new category and set of services. The purpose of this report is to identify these new services and to understand their role in the economy and to know what is demanded and who demands and supplies these new services.

II. UNDERLYING ISSUES OF THE ENVIRONMENTAL PROBLEMATIQUE

1. The changing character of environmental policy and management

6. Anticipatory, precautionary environmental policy has outgrown the ex-post, reactive or "repair" services and compensatory concepts for environmental damage that prevailed during the 1970s and early 1980s. Pragmatic, preventive environmental management has superseded the concept of environmental management understood as a sort of crisis management. The new approach is based on integrated systems for environmental management, protection and control rather than isolated, end-of-pipe technologies, environmental recovery, or payments to be made by way of compensation to those suffering environmental disruption.

7. Environmental management is moving from the "end-of-pipe" and the "add-on" type of solution to the "effluent-free plant" and "product life cycle" strategies. The new leading principles are: clean production, resource-saving processes, and emission and waste minimization. In the primary sector, the approach is moving from the "mining" of natural and environmental resources to their integrated management, which includes conservation, protection, enhancement and sustainable use.

8. The new approach, often called eco-management, is based on the integration

of environmental objectives into firm strategy, organization and operations. Although increasingly accepted, this approach has actually been adopted by only a small percentage of industry, mainly in some developed countries.[2]

9. The dominant end-of-pipe approach is a simple way to comply with regulations. End-of-pipe solutions represent the most costly way for industry to engage in pollution control and abatement. While the end-of-pipe strategy is confined to regulatory compliance, prevention strategies emphasize environmentally sound technology, environmental management and environmentally friendly products.

10. Environmental management includes the concept of life-cycle analysis and material and energy balance methodologies designed to reduce the release of gases and wastes, hence saving material and energy. Life-cycle analysis and assessment, also known as the cradle-to-grave approach, examine each stage of the life span of a manufactured good, from raw material extraction and conversion, through production, distribution, use, consumption, and disposal. More recently, with the increasing emphasis on product recycling, the so-called cradle-to-cradle approach is gaining momentum. Life-cycle analysis introduces environmental considerations into all levels and functions of productive activities.

11. The business sector has become involved in environmental activities for two main reasons. First, environmental compliance is becoming a component of business activity itself. Although the situation varies a great deal between countries and regions, legislative controls are becoming increasingly stringent, covering larger areas of economic activities. Laws and regulations, such as those concerning waste discharge, pollutant emissions, energy, land and resource use, urban and industrial development and the like, are an important boost for the environmental market for equipment, products and services. Environmental regulations actually create important new markets.[3]

12. The second reason is that the environment creates attractive business opportunities. In 1989 the Western European market for pollution control equipment, including everything from advanced waste disposal technology to catalytic converters, was estimated at US$ 40 billion. More than a million people in the European Union were employed in this sector, and it is related to services. The same year, the world market for anti-pollution equipment and cleaning products was valued at between US$ 200 and US$ 300 billion.[4] The OECD has estimated that the world market for environmental goods and services stands at US$ 200 billion, and that it will grow at a rate of 5.5% to reach US$ 300 billion by the end of the decade. These figures can be compared with those of the aerospace market, valued at US$ 180 billion, and the chemical market, valued at US$ 500 billion.[5]

13. Technological innovation has been behind the growing supply of environmental equipment and technology. Yet a mere technological response alone to the environmental problematique has proved to be insufficient, for many aspects of environmental policy and management require intangibles assets such as data, know-how, and capabilities to use knowledge and information. Anticipatory, preventive environmental policy and management demands new techniques, methodologies and different services, the supply of which is falling short of the increasing demand for them.

14. An increasingly environmentally aware public demands comprehensive reduction and elimination of all kinds of wastes, pollutants and toxic chemicals. The environmental concern of consumers is not only a social mechanism to control the environmental behaviour of Governments, local authorities and companies, but also an important driving force for the environmental market for goods and services. Environmental concern orients buying behaviour, generating a willingness to pay premiums for green or environmentally friendly products. The environmental premium, akin to the premium commanded by products which meet certain quality standards, has given rise to green labels. Product certification is gaining increasing support from consumers.[6] In the former Federal Republic of Germany, consumer behaviour favoured the introduction in 1977 of the Blue Angel, a comprehensive eco-labelling scheme which has certified over 3,000 goods

in about 60 product categories.[7] The "Green Consumer Guide", a bestseller of the early 1980s, contributed to the sharp rise in the number of "green consumers" in the United Kingdom.[8],[9]

15. Although several Governments and the EU are moving towards eco-labelling schemes, their adoption is not free from problems, and debate has emerged on several issues: should the label be awarded on the basis of the effects of the product when consumed? Or should it consider the overall environmental effects throughout the complete process of manufacturing, marketing and consumption that represents the complete life cycle of the product? Should it be awarded to products that are already green or also to those products that are becoming increasingly green? How is eco-labelling affecting competitiveness? Is it leading towards increasing standardization, hence uniformity?

16. Eco-labelling is a significant issue for the competitiveness of firms. In a market where competition is fierce, the question is how to harmonize environmental pressure with the need to preserve the pace of markets. Since the environment is nowadays a factor of competitiveness, innovations must incorporate environmental parameters in order to keep ahead of public opinion and government controls, thus allowing the firm to create comparative advantages and to lead competition.[10]

17. The strategy of "moving ahead" of consumer pressure, government regulations and the competition is tantamount to building up competitive advantages. The firm that takes the lead on environmental issues may find it can introduce technological innovations at its own pace, rather than under the pressure of new regulations with no time to evolve the most appropriate technical solution. Such leadership gives several advantages: it makes it possible to be the first with new products on the market, preventing the entry of rivals; it allows the firm to play an important role in shaping the way the industry is regulated;[11] and finally, the leader is able to anticipate the rising costs of being a polluter.

18. The desire to move ahead of government environmental regulation often induces the leading firm to set itself stringent environmental standards and to apply them worldwide. This is a risky decision, for competitors are not necessarily following the same policy, or because the firm's national partners may be reluctant to do it.

19. So the firm's competitive position is also defined by its capabilities to gain advantages over its competitors on the basis of its environmental assets. The dare is to offer products that are simultaneously user-advantageous, cost-competitive, timely and environmentally sound.[12],[13]

20. In addition, having an environmentally sound or green image is part of marketing strategies and an objective of a firm's public relations departments. This leads not only to demand for equipment and services for production itself but also to demand for services to communicate the environmental attributes of new products and processes, and for the creation and transmission of the environmental credibility required by public opinion.

21. Finally, Governments are pressing for transparency of corporations on environmental matters. Transparency is a component of the EU's Eco-management and Audit Scheme. The United States' Superfund Amendments and Reauthorization Act, section 313, includes provisions for unprecedented public access to environmental information about the different aspects of corporation activities.

22. To sum up, three main driving forces fuel the expansion of the environmental market: increasing and stricter environmental regulations, competitiveness, and public pressure.

2. The environmental industry

23. A most important and noticeable effect of the environment issue has been the rise of the environment industry. There is no clear-cut definition of what the environment industry is, and in fact any definition is difficult for, *inter*

alia, the following reasons.

24. There is no specific standard industrial classification (SIC) code to portray environment industry products. Numerous firms claim to operate in the environment market serving a great variety of fields including pollution-abatement and control equipment manufacture, water-treatment plant and construction, solid-waste and hazardous-waste management, engineering and consulting firms, analytical laboratories, scrap-recovery, recyclers and resource recovery firms, companies producing environmentally friendly consumer goods, and so on.

25. The environment industry is composed of many traditional firms that have extended their activities in order to produce equipment or to provide services for the management and solving of environmental problems.[14]

26. Environmental firms are rather new, and few of them are more than 20 years old; in France two-thirds of the existing firms providing environmental services are no more than 15 years old and more than 25% of them are less than five years old. In the United States, many environmental firms started during the late 1970s or early 1980s. In Italy, three-quarters of the firms operating in the environmental sector were set up after the 1960s. In the former Federal Republic of Germany, in spite of the incentives of the first Environmental Programme launched in 1970-1971, about one-third of the environmental firms initiated their activities after 1981. The quantification of firms pertaining to the environmental sector is a matter of controversy. A reasonable estimation is that there are more than 5,000 German firms offering equipment, plants, processes, technologies, goods, know-how and services for environmental protection.[15] No accurate data are available for the number of firms operating in other segments of the environmental sector. Altogether, OECD has estimated the number of American environmental firms at about 12,000. For their part, Wall Street experts reckon that there are no more than 80 firms of which shares are traded outside the Stock Exchange Market.[16] In Italy it is estimated that there are about 360 firms offering abatement technologies, and to this figure should be added more than 1,000 firms offering environmental services.

27. Environmental firms can be classified depending on what they provide: (i) equipment: treatment plants, scrubbers, end-of-pipe filters, equipment for collection and transport of waste, monitoring and control equipment, engineering and design; (ii) non environmentally damaging or environmentally friendly products such as biodegradable products, for example biodegradable plastics and biodegradable or non-polluting detergents, catalyzers, lead-free petrol, non-toxic paints, substitutes for polluting products such as PCB or CFC, and the like; (iii) environmental services, which include water management and purification, waste management, recycling, conservation of threatened or damaged natural areas and habitats, remedial services, environmental technological R&D, economic, legal and liability management, technical advice, management consulting, risk analysis and assessment, insurance services, data services and database management and environmental training.

28. Market analysts divide the environment industry into five branches: recycling or disposal of solid waste; recovery of deteriorated areas; air pollution control; water treatment; and engineering and consultancy services.

29. The OECD describes the environment industry on the basis of its product structure, distinguishing four main areas of environmental equipment and related services: water and effluent treatment; waste management; air quality control; and others, including land reclamation and noise. This classification does not consider the production of those technologies to be incorporated into the various industrial processes to save energy and materials or reduce residues, frequently named as low-waste, clean or environmentally sound technologies.

30. Equipment production represents nearly 76% of the value of the environment industry's output, while the remaining 24% is accounted for by services, mostly related to the installation of pollution abatement and control technologies. The equipment share is higher in Japan and lower in the United States, standing at

79% and 74% respectively.

3. Technology and the environment

31. Environmental technologies can be classified in the following five categories: (i) add-on or end-of-pipe technologies for pollution monitoring, control and abatement; (ii) recycling technologies; (iii) environmentally sound or clean technologies that incorporate environmental criteria from their conception; (iv) technologies for the production of environmentally sound goods; (v) technologies that reduce or modify the characteristics of inputs in the productive process;

32. Despite a vast array of technologies labelled as environmental or environmentally sound, most are actually technologies developed *ex-post-facto* in order to compensate for or to stave off the negative environmental effects of conventional technology.[17] They evolved in response to the dominant anti-pollution and pollution abatement policies of the late 1960s and the 1970s. The rationale was to provide a quick solution to comply with environmental regulations without modification of existing technological processes and routines. However, compensatory technological solutions have a series of limitations:[18] (i) they imply additional investment and costs in terms of human and financial resources to be allocated to R&D; (ii) they are frequently energy-intensive, often through polluting processes; (iii) they can cope with visible problems of pollutants and waste, and may be useful for the recovery, re-use and recycling of materials, but they hardly compensate for "invisible", non-"marketed" damage caused by conventional careless technology; (iv) they are mainly oriented to industrial processes and urban areas; and (v) they postpone the creation of real environmentally sound technologies, extending the trajectory of conventional environmentally careless technology.

33. In the long run, end-of-pipe technologies are likely to be replaced by new technological processes incorporating environmental criteria in their design. Most probably these new processes will require changes of productive cycles or the complete substitution of conventional technologies. Their development is determined by strategic criteria of medium- and long-term competitiveness and their investment implications.

34. Environmental R&D expenditures have increased in recent years, being even higher than those in traditional R&D areas: Italian industrial expenditures on environmental R&D are larger than those on energy-saving R&D.[19]

35. The new managerial approach requires diverse professional skills and new creative practices, methods, models and technology. In its turn, environmental technology brings forth the need for new skills and services needed to operate, maintain and repair the technology.

III. ENVIRONMENTAL SERVICES

1. The concept of environmental services

36. It is necessary to clarify the meaning of the expression "environmental services" used in this report. The expression has been used by experts dealing with the environment in relation to the basic non-marketed economic functions of the environment which, together with natural resources, constitute the natural capital. For many of these functions there is no market and therefore economic indicators or signals are non-existent. The absence of economic signals is often associated with the malfunctioning of market forces, yet in many cases it is more due to the fact that for services provided by nature markets simply do not exist. These functions have no market expression, they lack a price. This is the case of the water cycle and soil functions, clean air, biological diversity, landscape amenities, the assimilative capacity of nature (or sink function), and specific functions of ecosystems such as their self-purifying, buffer and regenerative capacities.

37. Human activities have increasingly used these natural functions without

any consideration for their rational use, adequate management, conservation and renewal, not to speak of their enhancement. The missing market expression, price, for these resources, together with the natural propensity to over-use common and free resources, resulted in the abusive use of environmental functions. The natural capital has been depreciated at growing rates, and it has been used without any replacement, resulting in a loss of environmental functions, which are therefore becoming increasingly scarce. The relevance of environmental functions and resources for productive activity, but above all for the survival of mankind, makes it imperative for the economic reckoning to include the loss of environmental quality and functions as capital depreciation to be charged against production.

38. In order to internalize the costs of the loss of environmental functions, economic activities should change in terms of their behaviour and organization, and new technologies, methods and tools should be introduced. In this connection, a complex gamut of new economic activities have emerged, among them a new type of services.

39. In this report those "services" provided by the natural system will be termed environmental functions,[20] or environmental resources, while the expression "environmental services" is used to refer to the economic activities that provide economic services related to environmental issues, meaning services necessary to deal with, and to solve, environmental problems or that permit the adequate use of natural and environmental resources and functions.

2. The demand for environmental services

40. With the rising environmental concern, the demand for environmental services has increased, yet there is no systematic information as to who consumes them and who provides them, and the type of service required is often poorly defined.

41. As in the case of the environment industry, the growing demand for environmental services is motivated by three leading forces: increasing and tighter legislation and regulation, public pressure, and economic and financial considerations.

42. Environmental laws and regulations, the setting of standards, and the adoption of sectoral or geographical environmental measures, as well as the adoption of national environmental plans, generate, directly and indirectly, a demand for environment-related services. In addition, States, municipalities and local governments are adopting their own environmental regulations, frequently more stringent, in order to cope with local problems, thus imposing extra requirements on firms.

43. It is obvious that the mere enactment of regulatory measures does not automatically result in environmental awareness. Complementary measures are needed to persuade firms and consumers to adopt environmentally sound behaviour. Complementary measures include the promotion and support of environmental R&D, the diffusion of information and environmental knowledge, the training of personnel, and the financing of programmes to promote environmentally sensitive decisions and their implementation in a cost-effective manner.[21]

44. Government policy contributes to the materialization of the demand for environmental services that otherwise are likely to remain something that nobody can afford because of the large and risky investment and the often meager short-term benefit. Many environmental services are provided by Governments and local authorities, which are in fact among the larger clients of the environment industry.

45. Available administrative resources to ensure compliance fall short in relation to the generation of environmental laws, jeopardizing their effectiveness. Authorities have to enlarge their environment departments, endowing them with skilled personnel and services such as data gathering and processing. The simple decision to set up a new environmental standard or

regulation creates a myriad of demand for services and skills.[22]

46. On the other hand environmental regulations require firms to have clear environmental credentials to accede to different traditional services or activities. Banks and insurance companies are asking searching questions about the environmental track record of enterprises seeking credit facilities and insurance cover. Investment trusts explore environmental classifications that can be used to rate the environmental risk attached to company shares. Environmental auditing, risk assessment analysis and the like are therefore needed, and for that industry relies on specialized consulting firms.

47. Similarly, environmental impact studies and assessment (EIA) are included in almost every regulation concerning new investment. EIA is a complex task involving different disciplines, field work, laboratory testing, etc., that ordinary firms can hardly undertake, so they have to resort to specialized consulting firms. This complexity also poses problems for the authorities, and often the administration has no capacity in this area. In some countries the EIA system involves an external review process which seems to be very effective.[23] In the 1980s EIA systems without external review mechanisms generally tended to falter.

48. Often EIA studies must be accompanied by additional technical reports; for example Mexican law includes the obligation to carry out risk assessment study for those activities considered to have a high risk or to be dangerous, such as the manipulation, processing, transport and use of toxic substances. Once again this type of study requires specialized professionals.

49. Laws, statutes and regulations can be of nine types:

(a) Performance standards that set up quantitative limits on the discharge of a particular pollutant from a source;

(b) Design standards that specify a technology or method of compliance;

(c) Process-oriented control to regulate manufacturing processes to prevent emissions, discharges or leaks;

(d) Statutes imposing different types of monitoring and notification requirements;

(e) Regulations concerning restrictions (including banning) on production, testing, sale, use and disposal of specific products;

(f) Laws imposing remediation and compensation to contribute to help clean up past environmental damages;

(g) Market instruments such as pollution taxes or tradable permit schemes;

(h) Permits;

(i) Regulations on the unlawful conduct of third parties with which firms have business relationships (e.g. a purchaser of real property may assume the environmental liabilities incurred by previous owners).

50. Environmental duties and requirements also come from national and international financing institutions. Financial markets require detailed environmental information and discriminate in favor of environmentally sound projects and companies. The Operative Directive issued by the World Bank provides that an environmental assessment is "normally" required for certain categories of project.[24] The European Bank for Reconstruction and Development (EBRD) publishes annual reports, and other reports as appropriate, on the environmental impacts of the Bank's lending operations. The need to provide environmental information to financial institutions results in demand for specific

environmental services.

51. A survey sponsored by UNEP[23] on the financial services sector shows that 75% of the respondents believe that environmental issues have a material impact on their business. It indicates that financial risk associated with environment liability arising from the extension of credit is becoming a major concern for financial institutions all around the world. Although environmental criteria are not yet explicitly included in overall lending and investment strategies, the study reveals that 80% of the respondents perform some degree of environmental risk management on the debt aspects of their business. In addition, over 50% of the respondents perform either environmental impact assessments or environmental credit risk analysis on a regular basis and add environmental criteria to the credit review process.

52. The same study says that the most frequent requirement by governmental and non-governmental institutions relates to environmental credit risk analysis. To perform such analysis, the financial service sector needs trained staff and accurate data on environmental matters.

53. In general, increasing environmental regulations result in increasing reporting requirements, i.e. data that must be collected, processed and evaluated. Besides *ex post* reporting information, there are also growing requirements for *ex-ante* environmental information in relation to planned activities.

54. The increasing need for environmental services is encountered by firms with different strategies:

1. Relying on services provided by environmental specialists;
2. Upgrading internal environmental divisions;
3. Creating specialized environmental firms as subsidiaries or joint ventures with other firms;
4. Acquiring small successful environmental firms.

55. A few examples can be given to illustrate some of these strategies. In 1988 DuPont invested nearly US$ 600 million for the management and elimination of solid waste and air and water pollution control, plus a provision of US$ 200 million for the preparation of future programmes. The same year Monsanto invested US$ 207 million in its own environmental programme.

56. Philips joined other manufacturers of batteries to set up an enterprise to recycle nickel-cadmium batteries. Bayer, BASF, and Hoechst created Duales System, an enterprise that collects, selects and processes used packing materials.[24] IBM took control of Valme (Valorisation de Métaux), a small enterprise in Calvados (France) specializing in the complete dismantlement of computers.

57. However the majority of firms have no capacity to undertake the above mentioned strategies and have to rely upon specialized environmental service firms.

IV. THE ENVIRONMENTAL SERVICES SECTOR

58. The increasing demand has stimulated the creation of several types of environmental service firms. A quick look at specialized directories, magazines, newspapers, advertisements and publicity reveals that experts and firms providing environmental services have mushroomed. It also gives the impression that these firms and experts deal with a large myriad of subjects.

59. In the United States, the OECD estimated that there are about 12,000 environmental and consulting companies, among them well known firms such as Arthur D. Little, Deloitte and Touche or McKinsey. In France different estimations put the number between 400 and 1,000, while it has been reported that in the United Kingdom there are 225 consulting firms providing, among other services, environmental auditing or auditing advice. The same source indicates

that environmental auditing represents about 5% of their time. This type of service can be named "soft" environmental services.

60. The environmental services sector is dominated by companies to which the environmental activity is the extension, sometimes logical although always very recent, of other activities. The largest eight French firms supplying environmental services make only between 5 and 45% of their turnover from purely environmental activities. The American Jacobs Engineering Group (Pasadena, California) derives only one-quarter of its business from environmental work. In Italy 40% of environmental firms make less than 50% of their turnover in environmental activities. Among the consulting firms, Arthur D. Little, one of the leaders in the environmental field, makes about 20% of its nearly US$ 400 million annual revenue from environmental consulting.[27] Obviously there are firms that are basically "environmental" such as Waste Management (now WMX), the large American transnational environmental services company, the Italian Daneco or the Swedish Abb Fläkt.

61. The sector has a high and increasing degree of concentration. In France 20 firms represent more than 80% of the total turnover of firms providing environmental services. Two firms, namely the Compagnie Générale des Eaux and the Lyonnaise des Eaux, own a complete network of subsidiaries involved in the collection and transport of wastes, incineration, incineration of toxic wastes, water treatment, etc., operating in France but also in other European countries, Asia, South America and North America. Concentration is particularly notable in the water and waste-water treatment sector, where these two firms together with Saur practically control the area. In the United States, the larger share of the environmental business is commanded by firms such as Browing-Ferris and WMX (the Waste Management group), which are rapidly expanding in Europe through subsidiaries such as Waste Management Nederland and Recycle Nederland Netwerk or by acquisition of the control of national firms in Italy or France (WM France). WMX operates in Spain, Mexico, Argentina, Australia, New Zealand, Indonesia, Sweden, Germany, Hong Kong, etc.

62. The market is dominated by well known consulting firms that have expanded their activities with the creation of environmental departments or specialized environmental subsidiaries. This is the case of Foster Wheeler (UK), Phillip Holzmann (Germany), Dames and Moore (USA) and many others. These firms provide what can be named "hard" services.

63. Environmental services fall under one of the following broad categories:

(1) Design and construction of environmental industrial plants and equipment;
(2) Environmental standards and controls;
(3) Studies, analysis and management of natural environments;
(4) Environmental impact studies and assessment;
(5) Eco-auditing or environmental auditing;
(6) Design and implementation of programmes on landscape management;
(7) Environmental projects;
(8) Advice on environmental strategies;
(9) Environmental law and legal services;
(10) Technical solution of environmental problems like waste treatment, recovery of residues, cleaning of damaged environments, management and recovery of contaminated land, clean-up programmes;
(11) Environmental risk and insurance;
(12) Eco-marketing;
(13) Environmental information and communication;
(14) Environmental training;
(15) Provision of environmental amenities;
(16) Technical and legal services for consumers;
(17) Design and management of conservation programmes;
(18) Environmental data systems, environmental software programmes, expert systems, and computer-aided environmental planning.

64. Generally an environmental firm acts as a main contractor for several

environmental services which require skills that traditional firms possess only partially. In this case what is appreciated is the capacity of a given firm to secure the collaboration of different specialized firms and to pool together their expertise.[28]

65. From the technology perspective, there is often no need for great environmental specialties but rather engineering capacity and/or capabilities for planning, coordination and management that can allow the firm to enter the market and to assume the role of main contractor.

66. A pattern prevailing in Europe is that the firms that supply equipment do not produce or construct anything with their own labour force; their role is either to engineer the equipment or the main technological component, or coordinate activities related to the construction of plants and physical facilities. Labour is normally provided by local builders. This is why environmental firms often appear to have only small employment impacts, since their manpower is actually composed of engineers, with little unskilled or wage labour.

67. It is likely that, within the overall environmental market the area of environmental services will grow at a higher rate than environmental equipment and related services, for industry is moving to more environmentally sound management and will incorporate energy and material-saving technologies and low- or non-waste technologies in their production processes. Efficiency in the use of raw materials and the trend towards material-saving will therefore increase, with diminishing production of residues, pollutants and wastes.

68. The OECD has estimated that the environmental market will expand at an overall rate of 5.5% but at a rate of 5.0% for equipment and 7.4% for services. The forecast results from a rate of expansion of 5.5% for the OECD countries, 4% for Central and Eastern Europe and 6.8% for developing countries. Since the OECD countries represent about 85% of the world market for the environment industry, the bulk of the demand will still be concentrated in developed countries.

1. Environmental services subsectors

69. The environmental services sector is highly fractionated, operating with a large number of engineering and construction contractors' firms, water treatment companies, solid-waste and hazardous-waste management firms, recyclers and resource recovery firms, individual environmental consultants, ecological advisors, landscape consultants and urbanists, environmental management consultants, environmental law counsellors, environmental impact assessment, environmental auditing and risk assessment and management consulting firms, and eco-marketing advisers, as well as firms specializing in environmental data systems, analytical laboratories and R&D centres.

70. The areas covered range from decontamination of soil and water, the design of water and air pollution control measures, environmental impact statements and assessment, environmental auditing, the marketing of environmental products, the management of protected areas, the conservation of threatened or damaged habitats, the design of new processes and products, chemical analysis and tests, and environmental R&D, to training and education on environmental matters.

(a) *Environmental engineering and design services*

71. This category includes firms and professionals from the engineering disciplines, the main asset of whom is technological knowledge and expertise. They are concerned with environmental damage and its physical measurement; the design of decontamination and pollution abatement equipment; and the design and construction of plant for waste and waste-water treatment. Frequently they design equipment and plant, ensuring their entry into operation and even participating in or undertaking their construction (e.g. Cerchimie and TES in France, or Daneco in Italy).

72. With reference to the UN Provisional Central Product Classification (PCPC), this type of service corresponds to those included in classes 86711: "advisory and pre-design architectural services"; 86721: "advisory and consultative engineering services"; and 86724: "engineering design services for the construction of civil engineering works".[29]

73. Engineering environmental firms frequently specialize in a particular sector: water, air, solid and hazardous waste, energy, remediation, noise, etc..

74. Nevertheless, real environmental specialists are scarce, most environmental engineering firms have activities that go far beyond the environment, and full specialization on environmental engineering and consulting is rare. Environmental activities, both on the engineering side and as they relate to advisory services, represent no more than 30% of their activities, for their main activity remains traditional industrial equipment and infrastructure.[30]

75. This is the fastest growing environmental service segment. In some cases this expansion has been promoted and facilitated by governmental policies and measures such as those provided by the American CERCLA, superfund remedial investigation and feasibility studies. In the United States, this type of environmental service firm had an annual revenue of about US$ 13 billion in 1991, with an estimated annual growth of 20 to 30%. This rate is likely to slow down, with an expected annual revenue of about US$ 50 billion by the year 2001.[31]

(b) ***Solid waste management, recycling and energy/resource recovery***

76. Population expansion and more diversified life styles generate growing amounts of industrial, agricultural and consumer waste.

77. In analyzing this, environmental services encounter constraints due to the poor definition of waste and of waste management, the lack of data and statistics, and difficulties in identifying firms according to the type of operation they perform: handling, selection, transport, treatment and disposal.

78. There is no clear-cut definition of waste, which is a social concept, for in nature nothing is lost and everything is transformed, re-used, recycled, and reincorporated in natural processes and cycles.[32] Besides, what is considered waste in a specific historical situation may not be in another, and similarly what is termed waste by a given society may not be in another. The concept varies in space and time.

79. In general, waste is anything that is discarded, whether it be toxic, hazardous, non-hazardous, liquid or solid. Wastes are substances that are not fully transformed, that have no economic value or for which recovery, recycling or re-use is not possible for technical or economic reasons, or because of social and cultural habits.

80. The generation of waste implies that nature is used as a sink: some of its properties, functions, processes or elements are used to clear away socially and economically unwanted substances. The natural system is providing services which nevertheless are not incorporated into the economic cycle: they are not traded in markets, hence not priced. It was traditionally assumed that the disruption resulting from such use of natural functions is so small that it can be disregarded. When the amount of the waste is kept below the limits that the natural system can degrade or absorb, the functioning of the natural system is not seriously affected, and it recovers its capabilities thanks to its resilience. However, when the volume and frequency of waste discharge increases, or the waste has noxious properties, cumulative and synergetic phenomena increase the virulence of the effects, which can become irreversible: the capacities of the natural system are exceeded and a process of environmental degradation is triggered. At that moment social intervention is necessary.

81. The partial transformation of materials, zero recovery and recycling, the release of gas and the dissipation of heat can be due to a poor understanding of materials dynamics, insufficiently developed techniques, their inefficient

or careless use, or social and economic reasons (high cost of recovery or of a more efficient transformation technology).

82. The OECD has defined solid wastes as all substances undiluted in water or in the air which a holder wishes to or must dispose of, with the exception of radioactive wastes from nuclear activities.[13] From an economic point of view, these substances should be treated as by-products of production processes and consumption activities. Solid wastes are covered by division 39 of the UN PCPC.[14]

83. Waste poses several problems: disposal, triage, management, recycling, etc.. To deal with them is the main objective of waste management, an activity included in the UN PCPC's division 62, class 62278: "wholesale trade services of waste and scrap and materials for recycling", to some extent in class 62279: "wholesale trade services of intermediate products, other than agriculture" and in division 91, class 91123: "public administrative services related to refuse collection and disposal operations, and street cleaning".[15]

84. Waste originates in all sectors: industry, agriculture, commerce, energy, health services, household consumption, transport, etc. One of the major generators of waste is agriculture; in the European Union, agriculture generates almost 50% of the total waste produced in the EU, though it is also the largest re-user of waste. Agricultural wastes have peculiar characteristics, and their management is basically a type of in-farm service. In 1990 the OECD countries generated around 9 billion tons of solid wastes, including 420 million tons of municipal wastes and 1,500 million tons of industrial wastes, which in turn included more than 300 million tons of hazardous wastes. To this figure should be added about 7 billion tons of agricultural wastes, residues resulting from energy generation, mining activities, demolition debris, dredge spoil and sewage sludge.[16] Growing and increasingly diversified consumption is raising the amount and variety of wastes, which could multiply four to fivefold by the year 2025.

85. Solid municipal waste management is becoming one of the most serious problems all around the world, particularly in urban areas of developing countries, where it is reaching dramatic dimensions. In the United States, it is estimated that nearly 160 million tons of municipal solid waste are generated every year, of which 40% by households and 60% by commercial and industrial establishments. A European consumer rejects 1 kg per day, and this implies about 150 billion metric tons per year in Europe. Forecasts indicate that the problem will continue to grow, and collecting, transporting, sorting, recycling, treating or burning such waste is a major challenge faced by local and municipal authorities.

86. Although there are no authoritative data, nearly 65% of waste produced in the OECD countries is disposed of in landfills, 15% incinerated on land, and 17% either dumped or incinerated at sea, while the remainder is treated chemically or exported and dumped in developing countries.

87. Disposal facilities in developed countries will diminish as a consequence of more stringent legislation, making an already existing problem more serious, for the existing disposal facilities are able to receive safely only about 50% of the total waste generated. Landfills are becoming increasingly scarce and indeed should be progressively reduced. By the end of the decade, waste disposal costs could double or triple as disposal sites fill up and stricter environmental controls are imposed.

88. Until recently, waste management, particularly municipal waste management, has been a public service. The situation is, however, changing due to: the growing volume of waste generated; its increasing diversity; the operational and technical complexity of disposal particularly in the case of hazardous waste; the need to comply with increasingly severe legislation and stringent technical, economic and environmental standards; the important capital investment involved.

89. The solid waste service market is expanding because of the growing and more

diversified generation of waste, the tendency to contract waste management services outside the firm, and the increasing privatization of many public environment-related services. It is estimated that in Western Europe there are now more than 50 companies with annual revenues of more than US$ 1.5 billion offering waste management services to both public and private organizations.

90. Solid waste management, including recycling and energy/resource recovery, is a multi-billion dollar business, worth US$ 46 billion in the United States in 1991, without including hazardous waste management, and it is forecast to reach US$ 63 billion in 1996 and US$ 80 billion in the year 2001, meaning an average annual growth rate of 5 to 7%. These growth rates are apparently slowing down in the United States, while Europe has yet to experience them.

91. This environmental service category refers to at least four types of operation, each of them constituting a service in itself and allowing the possibility for a sort of firm specialization, yet it is also frequent that a single firm provides more than one of the four, or even all four services.

(i) Collection, transportation and landfill operations

92. A basic component of waste management services involves waste disposal and destruction. According to the OECD about 70% of the municipal waste of the EU countries and 60% of that in the United States is disposed of in landfill sites. The percentage is lower in Japan, i.e. 38%, while in some individual European countries such as Belgium, France, Italy, Sweden and Switzerland, the percentage is lower than 50%. In 1985, estimated disposal costs for solid waste ranged between US$ 200 and US$ 2,600 per ton, with an average cost of US$ 500 for non-incinerated disposal and US$ 1,500 for incinerated disposal.

93. The problem is that while waste generation mounts, landfills become increasingly scarce, and incinerators and other waste treatment plants encounter growing public opposition and increasing difficulties to locate. So the difficulties and costs of getting rid of ordinary rubbish are augmenting. One-third of current landfills in the United States will be out of space in less than 10 years. In addition, waste disposal costs are increasing, having tripled or quadrupled in several locations in the United States.[11]

94. In Germany the landfill disposal price has increased as a result of stricter legislation. In 1987 the dominant management practice was classification of ordinary waste with an average cost per ton of DM 20, with tightening landfill standards, costs doubled in 1989 and reached DM 120 in 1991. The current average German landfill disposal price is higher than DM 200. The annual generation of garbage in Germany is estimated at about 30 million tons, with packaging waste representing about 30% by weight and slightly over 50% by volume of household waste yearly. The Federal Environment Agency considers that, of Germany's 600 landfills, 500 will be closed by the year 2000 and the countries landfill capacity will be exhausted by the year 2020. On the other hand, the public opposition to incineration has contributed to increasing the costs of incineration facilities, which in some cases are beyond the limit of economic viability.

95. The Commission of the EU is establishing standards for waste disposal, including directives for landfill sites which will make them more expensive, increasing also the requirements and costs for their monitoring.

96. A consequence of the treatment of wastes by specialized plants, the search for new locations for disposal sites and the reaction against incinerators is that the transport of wastes has increased notably. Two alternatives are considered: road transport or rail. Traffic congestion and the associated risk of waste transport, particularly in the case of hazardous waste, seem to favour the second alternative. There are also economic reasons: waste lorries require additional fuel, wear increases, there is a need for extra and ad hoc vehicles, staff costs increase, etc. It is also argued that road haulage increases emissions of carbon dioxide and nitrogen oxide. In Germany a waste-by-rail and waste-to-energy-plants scheme has been adopted. Nearly 300,000 tons per year are

brought by train from eight transfer stations to the Schwandorf waste-to-energy plant in Bavaria. Other schemes operate from Emden and Langwedel to the Bremerhaven incinerator or to other Bavarian areas such as Nuremberg, Coburg or Kempten. The distance between the sources of wastes and the plants fluctuates between 40 and 186 km, averaging 74 km; 40 km is considered the minimum viable distance to compete with road transport.

97. Waste transport is an expanding and profitable new service, as proved by Laidlaw Environmental Services of Canada, a large firm specializing in waste haulage, particularly for hazardous waste.

98. The mounting difficulties of disposing of waste have induced the export of waste to countries where disposal costs are still low, landfills are available, regulations are more lenient or non-existent, or enforcement does not operate. Most of these are developing countries. Germany is the largest European exporter of wastes, and until 1988 it was exporting around 2.1 million tons to the former German Democratic Republic. After reunification, this export was shifted towards other, mainly developing, countries. To incinerate a ton of residues in Europe can cost up to US$ 2,000, while discharging it into any site in West Africa costs only US$ 20.

99. Another effect of landfill scarcity and increasing disposal costs is that the search for new waste reduction and recycling technology has become more attractive.

100. Waste management services are provided by thousands of firms, frequently local in character and operating official landfills: many of them face the risk of closure because of new stringent design and operating standards or because of growing competition from larger firms. This is a large and expanding environmental service segment that is coming to be dominated by large transnational corporations such as Waste Management (WMX) and Brown Ferris Industries (BFI). In the United States this market is estimated at US$ 30 billion.

(ii) Waste-to-energy conversion

101. There are different types of waste-to-energy conversion: waste incineration, or generation of refuse-derived fuels.

102. Waste incineration is a capital-intensive process and very sensitive to both the scale of operation and the cost of capital. It is very much dependent on the composition and quality of waste: where the waste has a high heat content, the energy recovered, in the form of either heat or power, can reduce the incineration costs. In the United States there are 153 plants currently in operation and nearly 53 under construction. In the EU there were more than 500 incinerators of municipal waste, of which about 80% have energy recovery facilities. It is estimated that the municipal waste of the EU could provide energy equivalent to the burning of 1.5 million tons of coal per year.

103. Refuse-derived fuel (RDF) refers to the transformation of municipal solid waste by separating, in a series of stages, the combustible portion of the waste. The product is either a loose fuel or a condensed pellet. This system can be combined with material recycling schemes for glass, metals, paper, etc., for which there are secondary markets. This scheme has been developed and is gaining momentum in the United Kingdom, Germany, Italy and the United States.

104. This environmental service tends to be very concentrated and to be operated by large firms that have the capacity to build up the required plants: in the United States there are 137 plants for the conversion of waste into energy operated by firms such as Westinghouse, Foster-Wheeler, Wheelabrator Technologies Inc (a subsidiary of WMX) and Ogden, which together represent nearly 70% of the American market, estimated at US$2 billion.

(iii) Recycling

105. In the early 1970s, waste was defined as a resource in the wrong place. Waste has indeed a value and frequently it can be turned into something profitable depending upon economic, social and technical conditions. Waste can be re-used or recovered for its original purpose, it can be recovered for different purposes, or it can be recycled, i.e. returned to the same production cycle it came from.

106. Roughly one-third of the waste generated in the European OECD countries is subjected to recovery operations of some kind.[38] About one-third of the nearly 45 million tons of metal (aluminum, copper, zinc, lead and tin) consumed annually in the OECD countries comes from the recovery of scrap and other metal residues.

107. The recycling and recovery of municipal waste encounters several difficulties and has met with different degrees of success, depending also upon the country. Problems relate to the segregation of material, for different wastes cannot usually be mixed in recycling processes.

108. Recovery operations include reclamation, recycling, direct use and alternative use, which require the following main activities: collection, storage, transport, treatment of wastes and also the disposal of wastes generated by these activities themselves.

109. The volume of waste recovered annually throughout the world is estimated at about 300 million tons, employing between 300,000 and 350,000 persons and producing an annual gross revenue of nearly 32 billion Ecu.[39] The market for this service is estimated in the United States at US$ 2 billion.

(iv) Industrial resource recovery

110. This market is formed by the reclamation of spent industrial materials, i.e. scrap. It is a technology-intensive activity and tends to respond to the fluctuations of organized markets. In the United States, this service is estimated to be worth around US$ 12 billion per year.

(v) Waste reduction

111. The transition from the end-of-the-pipe approach towards a preventive anticipatory one implies that the guiding principle should be the avoidance of waste creation. The US Office of Technological Assessment defined waste reduction as "in-plant processes that reduce, avoid and eliminate the generation of waste".[40] Activities undertaken after residue or waste has been generated are therefore not considered "waste reduction". Similarly out-of-plant recycling, disposal and treatment of wastes are excluded as methods of waste reduction. The US Office of Technological Assessment has identified the following methods of waste reduction:

(a) In-plant recycling;
(b) Changes in process technology;
(c) Changes in plant operation;
(d) Substitution of inputs, mainly raw materials;
(e) Output modification using low-waste or non-polluting processes.

(c) *Hazardous-waste management*

112. Hazardous wastes are those posing special problems because of their toxicity. They need special care for their storage, transport and disposal to ensure that they are isolated from human contact and to prevent them from contaminating the environment. They include a wide variety of substances, although nearly 50% of them come from the chemical industry. The metal, petroleum, leather and tanning industries are among the larger generators of hazardous waste. A special category of hazardous waste involves hospital wastes.

113. World hazardous-waste generation is estimated at about 340 million tons per year, of which nearly 300 million tons are generated in the industrialized countries and 81% of that or about 275 million tons in the United States.

114. In the United States it is estimated that there are more than 50,000 land sites where hazardous wastes have been dumped without any control or illegally. The cost of dealing with the results of this uncontrolled dumping of hazardous waste was estimated in 1988 at US$ 19 billion.[41]

115. Hazardous-waste management in the United States is a US$ 14 billion business, with an expected growth rate of 2%-3%, thus reaching US$ 18 billion by the year 2001. Chemical waste management represents the larger share, while nuclear waste and hospital/medical waste account for about US$ 1 million each. The sector is controlled by large multinational firms, headed by WMX Technologies Inc. (former Waste Management) through its subsidiaries Chemical Waste Management in the United States and Waste Management International PLC based in London and conducting all WMX's waste management operations outside North America. They are the largest providers of comprehensive hazardous and low-level-radioactive waste services, including: hazardous waste reduction, recycling and resource recovery, trash-to-energy, collection and transportation, storage, treatment, stabilization, thermal destruction, low-level-radioactive waste processing, site assessment, licensing, radiological controls, decommissioning, transportation and disposal.

116. The magnitude of this activity is revealed by the revenue of the firms specializing on it: in 1993 the revenue of Chemical Waste Management stood at US$ 662 million, while that of Waste Management International was US$ 1,411 million; the former has 4,400 employees and the latter 16,400. Other firms include Westinghouse (mainly incineration services) DuPont (mainly aqueous waste treatment), and Laidlaw Environmental Services of Canada (specializing in transportation).

117. The increasing cost of hazardous waste disposal[42] stimulates its export to countries with available landfills, low disposal costs, lenient or non-existent regulations or poor enforcement. To dispose of hazardous waste in Africa costs between US$ 100 and US$ 2,000 per tonne. It is estimated that the average disposal cost for hazardous waste in Africa is 4 to 25 times lower than in Europe and 12 to 36 times lower than in the United States.[43]

(d) ***Remediation services***

118. This environmental service refers to clean-up activities and the emergency response to specific accidents (such as spill clean-up).

119. Although still under recognized, the problem of contaminated land is becoming particularly serious in both developed and developing countries and goes much further than the contamination resulting from accidents. Land contamination has several causes, and it can be widespread or diffuse, resulting from large-scale applications of contaminants to soils, as in the case of pesticides and agro-chemicals in general; it can result from atmospheric fall-out originating in nearby industrial or urban areas, from uncontrolled waste disposal, particularly hazardous waste, or from poor industrial management and faulty technologies, for example leaking pipes and tanks.[44]

120. The most frequent and extremely expensive method is to dig up the soil and dump it elsewhere. It has been reported that, in the United Kingdom, to clean up a 60 hectare site contaminated with heavy metals and asbestos cost US$ 45 million and involved excavating 1.2 million cubic meters of soil, transporting it to a licensed landfill and replacing it with a million tons of sand dredged from an adjoining river. The complete task took two and a half years.[45]

121. New techniques have been developed in recent years in order to clean soil *in situ*, but they are very expensive and both capital and labor intensive.

122. Firms active in these types of environmental services include

engineering/construction enterprises (see (a) above) and consulting firms relying upon subcontractors for the construction phase of the cleaning/remedial service.

123. There are no reliable data concerning the magnitude of this market. In the United States, it is estimated at between US$ 7 billion and US$ 11 billion per year. In the United Kingdom, land cleaning represents 3% of the estimated UK environmental market of £4.1 billion.[46]

(e) *Water and waste-water treatment*

124. Ponds, lakes, groundwater, rivers and seas are increasingly used as uncontrolled disposal sites, so they are becoming dirty and even toxic for vegetable, animal and human life. Water treatment is a huge and growing market.

125. Industrial plants are increasingly equipped to treat their water effluent by mechanical, chemical and biological means. However, drinking water must be decontaminated, and inland waters need oxygen treatment to restore life whenever it is threatened by increasing discharges of and consequent decomposition of organic matter of human, animal, industrial or agricultural origin.

126. This category of environmental service includes suppliers of equipment, chemicals and other materials, consulting engineering and construction services. The services relate to several classes included in division 86, class 91123: "administrative housing and community amenity services" and division 94: "sewage and refuse disposal, sanitation and other environmental protection services" of the UN PCPC.[47]

127. Information and data concerning this market are difficult to get, for it includes many firms with a long tradition in water management which until recently were not considered as operating in the environmental field, such as the Lyonnaise des Eaux or the Compagnie Générale des Eaux. In the United States, the market was estimated in 1992 to be worth US$ 23 billion with a growth rate of between 3% and 5% through the end of the decade. However this figure includes, without any clear distinction, different items such as: industrial and utility capital expenditures, industrial wastewater treatment and maintenance, municipal and private water utilities' capital and maintenance expenditure, and municipal sewage treatment.

128. Large firms such as Foster Wheeler Enviresponse, DuPont, Groundwater Technology, Lyonnaise des Eaux-Dumez, Compagnie Generale des Eaux, Wheelabrator (a subsidiary of WMX) operate in this area. Their transnational character can be seen from the fact that, for example, 42.5% of the 93.6 billion French franc revenue of the Lyonnaise des Eaux-Dumez is generated outside France.[48] The firm operates in 80 countries, including the United States, Australia, Canada, the Czech Republic, China, Germany, Argentina, the Congo, Mexico and Thailand. It currently has a ten year contract to manage, together with Mexican partners, the water and water treatment services in the Federal District of Mexico City. A similar contract with Aguas Argentinas involves the major modernization and expansion of the water distribution network and waste-water treatment installation in Buenos Aires, an investment of six billion French francs; when completed, the network will have the capacity to serve a population of nine million. Through its subsidiary, Degremont is building the new drinking water plant for Bangkok, Thailand, the Mesa drinking water plant in the Philippines, the Buaran plant in Indonesia, the Ambatale plant in Sri Lanka, and the water supply system in Gabon, as well as others in North America, Asia, Africa and Latin America.

129. Municipal effluent is a main source of water pollution, and its treatment requires large investments, normally preceded by assessment studies. The assessment services refer mainly to:

- Wastewater treatment construction grants;
- Municipal wastewater treatment construction projects;
- Water discharge permits for new sources;
- Research and development projects;

- Ocean disposal site designations.

130. In developed countries, these evaluations are carried out by governmental institutions such as the United States EPA agencies or their equivalent. In 1980 the EPA published a study on the evaluation of the Environment Impact Statement (EIS) Programme for Wastewater Treatment facilities covering 58 EIS. The evaluation found that the EIS was effective in: (a) causing major changes in projects; (b) providing more protection for the environment; (c) improving opportunities for public participation in the decision-making process; and (d) providing cost savings that were the result of project changes prompted by the EIS process.

(f) *Air-pollution control*

131. Air-pollution control services refer to activities relating to engineering design and construction, equipment production for pollution control and abatement at stationary pollution sources (e.g. power plants) and mobile sources (e.g. catalytic converters on vehicles), clean alternative fuels and additives (e.g. methanol) and instrumentation for emissions monitoring. Some of these activities are included in class 94040: "cleaning services of exhaust gases", of the UN PCPC.

132. In the United States, this market is estimated at around US$ 20 billion, including US$ 5 billion for air-pollution control equipment and related services for stationary sources and about US$ 8 billion for equipment for mobile sources (mainly catalytic converters). The United States forecast for the year 2001 is US$ 30 billion, which is considered very conservative, for it underestimates the market for mobile sources and does not include investments in alternative fuels and additives.[49]

133. The leading firms operating in air-pollution control equipment are the Swedish Flakt; Air and Water Technologies (Research Cottrel), Wheelabrator (a WMX subsidiary), Joy Technologies and Environmental Elements. Major service firms on air control are: ABB (Asean Brown Boveri) and Air and Water Technologies.

(g) *Analytical laboratory services*

134. These environmental services are provided by laboratories that analyze environmental media samples - air, soil, water, sediment samples - for monitoring, auditing or remedial purposes. They are included in division 85: "research and development services" of the UN PCPC.[50]

135. In the United States, this market has been estimated at about US$ 1.7 billion, with a 5 to 7% annual growth rate. It is more of a national service than those examined in previous sections, although some transnational corporations are present as partners, providing technology and capital, for local laboratories.

(h) ***The ecological consulting firms***

136. This is a category of services that is clearly ecological in character. The staff of the firms concerned come mostly from the living sciences disciplines - biology, ecology, geography, and city and regional planning - and their approach is mainly global: they tend to be focused on analysis and assessment of environmental problems rather than on the techniques to deal with them. Capacity to diagnose rather than to cure seems to be their main asset. Their activities tend to concentrate on environmental impact studies and assessment. These services can be termed environmental protection services[51] and include also traditional ecological and conservation activities, such as services related to wildlife preservation and the management of natural areas.

(i) ***Environmental auditing services***

137. Environmental auditing tools have evolved in response to specific needs encountered by firms and Governments. The first type of environmental auditing

was a response to environmental regulations; it was a way for a company to check that it was complying with the increasingly voluminous and complex environmental regulations of the early 1970s, and it comprised environmental reviews, survey assessments or quality controls.

138. The need for eco-auditing increased in the 1980s in the United States with the creation by the Congress of the Superfund, a trust-cum-retroactive-law by which firms can be held liable for the dumping of waste. Fear of incurring liabilities in the Superfund led to the practice of auditing all new acquisitions. Today the regulations force companies to review the environment in which they operate and to make their activities conform with standards and norms, but in addition it is recognized that environmental auditing as an environmental management tool helps to improve a firm's overall performance. Environmental auditing has therefore evolved towards a mechanism of self-examination for internal operations, processes and technologies, including administration, services and transport, as well as investment decisions likely to have environmental implications, or in order to spot where environmental and human health problems might arise.

139. In this perspective, environmental auditing is a method of management involving a complex task of data collection and processing to verify processes, products and management activities of the firm with a view to their optimization. It is also a tool for the identification of potential hazards and risks. To sum up, environmental auditing is a tool for:

(a) The assessment of environmental risks;
(b) Environmentally sound management; and
(c) Ensuring quality: "total quality management".

140. It is used to make a distinction between public audits, meaning those audits performed in order to assess and facilitate compliance with the law; and private audits, which are those embodied in the management practice of the firm. In terms of purpose, they can be categorized as audits of:

(a) Compliance, for the assessment of the observance of rules and laws;
(b) Accidents, for the assessment of civil or penal liability;
(c) Acquisition, in the case of firms' acquisition or merging;
(d) Risk, for insurance contracts;
(e) Energy, to assess energy performance;

141. A comprehensive approach defines environmental audits as: a basic management tool comprising a systematic, documented, periodic and objective evaluation of how well environmental organization, management systems and equipment are performing.[52]

142. Services related to environmental impact assessment and environmental auditing do not appear in the current systems of classification of economic activities. Division 86 of the UN PCPC appears to be the most logical one to include services related to environmental impacts, statements and accounting. In particular, sub-class 86501 on general management consulting services, for both tools, EIA and EA, refers to business policies and strategies, as well as the need to define management information system, managements audits reports and controls.

(j) ***Management and assessment of environmental risks and insurance services***

143. The last decades have witnessed large environment-related accidents. Many of them involve rather isolated events and are clearly linked with specific activities (e.g Torre Canyon, Amoco-Cadiz, Exxon Valdez, etc). Other environmental accidents are the result of long periods of unknown incubation (e.g. Love Canal, Seveso, etc.) or associated with technical mishap with unexpected, colossal environmental consequences (e.g. Bophal). In addition to these widely reported disasters, there are more and more less spectacular accidents, which tend to go unnoticed and are not even reported by the media.

144. They are called environmental accidents since environmental disruption is their characteristic, or because they occur as a consequence of anthropogenic intervention in nature, or finally because the environment is the medium through which an expected event has pervasive negative effects, with the environment acting either as a spreading or as an amplifying mechanism. An example of the first is provided by oil spills in open seas, the second is illustrated by deforestation, and the last by the consequences of the regular discharge of toxic chemicals on the environment, causing diffuse pollution, such as that resulting from the use of pesticides, or the sudden release of toxic substances, as occurred at Seveso and Bhopal.

145. Environmental accidents are very harmful to a firm's image and in addition have proved to be very costly, for each accident carries not only direct financial penalties but also indirect costs. By the middle of 1990, Exxon had already spent US$ 2 billion cleaning up the Alaskan oil spill, which indeed led many American shipowners to raise liability insurance from US$ 100/US$ 150 million to about US$ 750 million. Insurers are reluctant to cover pollution risks over US$ 1 billion.[1] In Europe, the magnitude of compensatory settlements of all kinds is converging but it is still about one-fifth of those awarded in American courts.

146. One month after the Valdez accident, Exxon faced 31 lawsuits and 1,300 claims, including an extra action for US$ 2 billion jointly against Exxon and Alaska Pipeline Co. At the same time Exxon was hiring 4,000 persons to undertake the cleaning of the 3,035 miles of Alaska's coast affected by the accident, at a cost of hundreds of millions of dollars.

147. However, more than liability for accidents, whether big and dramatic or local and small, what concerns firms is liability for day-to-day pollution. The border line between sudden environmental damage covered by insurance policies and gradual damage not covered by them can be very tenuous. This is particularly so in the United States, where courts of justice are examining cases in which firms accused of pollution claim that insurance policies cover all or part of their pollution liabilities. In the United States, liability for the cost of cleaning up waste sites may fall on almost anybody who has ever been involved, including the operator of the site and any company whose waste was ever dumped on the particular site. Moreover, the law establishes the principle of strict retroactive liability on environmental matters. This means that firms are liable for cleaning-up costs regardless of fault or negligence or even if the pollution was caused by a previous owner of the site; they can also be held liable for dumping that was perfectly legal at the time when it occurred.

148. Insurance premiums for pollution insurance, accidents aside, are extremely laborious to design and very expensive. Many insurance companies have taken the option of avoiding this line of business, but this is not easy. In the late 1980s more than 100 cases against insurance companies were being examined in the United States courts of justice, one for more than US$ 1 billion, and in one litigation a single firm presented claims against 270 separate insurers for their environmental liabilities.

149. For the insurers, the environment can be very expensive; the US$ 470 million paid by Union Carbide (up to 1990) to Indian people affected by the Bhopal accident was almost completely covered by insurers. The Exxon-Valdez accident will certainly result, when payments are completed, in large losses for the insurance business. Nevertheless, insurance companies are starting to discover new opportunities for business in relation to leakages and disposal of toxic wastes.

150. Several companies face difficulties in getting insurance coverage for their activities, and this is particularly so for environmental service firms. Waste management, particularly when potentially toxic, is inherently prone to environmental accidents, and in fact an "environmental cleaning process" can be at the origin of accidents caused by, for example, leakages.

151. Petrol stations also encounter difficulties in getting insurance. It is

estimated that 68% of British petrol stations have hydrocarbon leakages into the soil, and the Environment Protection Act imposes on owners the responsibility for cleaning them up, but British insurers exclude soil decontamination and cleaning process from insurance coverage, although they may cover the repair of pipes and reservoirs.

152. Still other economic activities facing difficulties in getting insurance relate to products with a potentially hazardous character that can take a long time to materialize. For example, in the United States asbestos-related accidents have turned out to be among the largest environmental accidents with the inconvenience of a time lag between an insurance policy being written and the claims coming. Asbestos-related insurance liability could be between US$ 20 billion and US$ 50 billion, and at these levels many insurers may consider that the business is not worth entering. Even now they may feel themselves highly exposed because of insurance policies already written in this field for which claims could still be coming in the next century.[74]

153. Some national laws require that the firms responsible for environmental cleaning should be financially liable for the consequences of their work. This type of regulation and the huge indemnities imposed by courts result in reluctance on the part of insurers to cover the cleaning process. It is not uncommon, therefore, for large environmental firms to be in a situation of self-insurance, frequently through a subsidiary.

154. Chemical firms are among those prone to environmental accidents, for they typically produce between 50 and 70% of all hazardous waste, either in the course of the manufacturing process or in the form of final products. In the OECD countries, more than 200 serious chemical accidents occur each year. In the United States, around 7,000 accidents involving hazardous chemicals occurred between 1981 and 1985.

155. There is therefore increasing concern about environmental risks, which are defined as the probability value of an undesirable event and its consequences that arise from a spontaneous natural origin or from a human action that is transmitted through the environment, causing harm to people who have not voluntarily chosen to suffer their consequence, and their environment. Environmental risks can be classified in three categories:

(i) Risks related to long-term pollution resulting in adverse effects on health, the natural system or the economy. The first case (effects on health) refers to genetic modifications, birth deformities, cancer and the like associated with pollution. The effects of acid rain on forests and natural ecosystems illustrate the second. Finally, economic damage is present in both previous cases, for they have an economic dimension, but there are also direct economic effects such as the increasing cost of the maintenance of structures and equipment caused by pollution or the need to install cleaning equipment;

(ii) Risks of potential accidents in industry, agriculture, transport, etc., such as: tanker accidents, nuclear and chemical plant accidents, failures of dams, pesticide accidents, etc. More than 60 significant accidents of this type were identified in the OECD countries alone between 1975 and 1985;

(iii) Finally, there are risks related to natural disasters, such as earthquakes, tornados, volcanic eruptions, etc.

156. All environmental risks share a number of peculiarities, one of the most important being the uncertainties concerning: the probability of the event's occurrence; the nature and scale of the danger; and the likely extent of the damage.

157. Increasing environmental concern and the frequency of environmental accidents have motivated proposals for compulsory insurance of environmental

risks. This could mean that firms using particular processes and materials or operating in specific areas would be legally obliged to take out insurance cover. However, environmental issues pose a diversity of problems for conventional insurance practices. One of them is the high degree of possibility of materialization of a given risk among those exposed to such a risk. For example, in 1984 in the United Kingdom there were 5,256 licensed sites for the disposal of controlled waste, of which 1,006 had potential landfill gas problems[55] and over 50% were closed and might need controls, while the Waste Disposal Authority considered that surveys were likely to discover others requiring remedial action. This implies that the normal practice of spreading the costs of misfortune befalling a few among many running the same risk cannot be followed, for the 1,006 highly risky sites constitute too high a proportion of the total number of registered sites.

158. In addition, the costs involved are relatively high: in the United Kingdom, the cost of investigation alone, not cure, is estimated at US$ 30,000 per hectare, and remedial work on gas problems would exceed, according to reliable estimates, US$ 16 million over a five-year period.

159. Moreover, environmental deterioration, unless caused by an isolated accident, normally occurs over long periods of time, posing difficulties for the identification of an adequate policy. The situation is further complicated by the fact that gradual pollution risk requires a funding mechanism for after-care, once operations have ceased at the waste disposal site. Two problems arise: the first is the period of insurance compared with other types of long-term insurance: for a waste disposal site, for example, it is estimated at 50 years, calculated on the basis of 20 years' expected life plus a post-closure period of 30 years requiring after-care. The second problem refers to the difficulties encountered in the reckoning of long-term costs of after-care or remedial work at a waste disposal site or the site of the accident, a situation illustrated by the Seveso, Bhopal and Exxon-Valdez accidents among others. This means that reserving against future claims is complex for the insurer and is likely to be further complicated by the tax treatment of funds created in the absence of reliable historical statistical data for actuarial valuation.

160. In relation to the last point, two aspects should be raised: one concerns the high cost involved and the uncertainties associated with the estimation of such cost. This leads to the second aspect, which is the availability of reliable statistical data. The actuarial rating of insurance premiums requires historical statistical data which unfortunately do not exist yet. In the absence of adequate information, premiums may be inadequate for the risk.

161. In such a situation it may happen that the insurer will be unwilling to provide coverage. In this case authorities can go further and make it compulsory for the insurer to provide coverage for environmental risks, which will imply either that Governments would have to provide financial guarantees or that the insurer would have to subsidize the compulsory environmental insurance from other types of business, as a result of which the cost of the latter is likely to increase.

162. This issue creates other opportunities for environmental services, that is the management of environmental risks firms. Although the technique is still at the early stages of development, it is likely to have an increasingly important role in economic and environmental decision-making. Environmental risk management includes risk assessment and management techniques for the identification, estimation, evaluation and management of environmental hazards, followed by risk reduction. Environmental risk management has to overcome several methodological and practical problems: the identification of environmental risks is not easy, and it frequently occurs long after serious consequences have already been felt; risks can never be measured precisely; they involve a complex set of cause-and-effect relationships, and are often interlinked with each other; risks tend to be widespread over large areas and sectors; and finally, social evaluations of risks tend to be very dissimilar.

163. This type of environmental service, being very new, lacks data and does

not appear explicitly in any international classification of economic activities. The UN PCPC does not identify them explicitly, suggesting that they may fall under the category of Other Insurance Services protecting policy-holders against risks not elsewhere classified.[56]

(k) *Environmental monitoring and data*

164. The design, implementation and control of environmental policy and management requires important amounts of data of different types and origins, and it should be possible to manipulate this information in order to use it for practical purposes.

165. Meeting the needs of Governments and firms has been facilitated by the development of microelectronics, telecommunications, computing, etc. The expansion of informatics has gone hand in hand with the dramatic decline in the costs of collecting, processing and transferring data associated with the rapid expansion of the data-service industry.

166. In 1989 more than 400 software programmes on environmental regulations and data for Governments, enterprises and consumers were available in the market. Yet the dynamic character of the environmental problematique has resulted in new needs in terms of knowledge, information and data. To deal with the environment requires the regular gathering and assessment of information and its use in an evolving context.

167. The need to comply with regulations and the adoption of internal environmental management has motivated some firms to evolve their own environmental data system.[57] The EU's directive on Environmental Information and Title III of the 1986 US Superfund Amendments and Reauthorisation Act require that companies have to report all the pollutants they emit. Many companies realized that they did not even know what they were releasing, and today corporate management has to get and use environmental data as regularly and systematically as it uses financial information. The adoption of environmental auditing generates additional pressure for the development of environmental data systems.

168. The design and implementation of national or local environmental policies, strategies, measures, standards and criteria requires detailed, timely and accurate information and data systems for:

(a) The diagnosis of the state of the environment;
(b) The identification of causes of environmental deterioration;
(c) Monitoring of the state of the environment;
(d) The design of adequate environmental regulations;
(e) The preparation of adequate environmental laws by legislators;
(f) Enforcement of regulations.

169. Progress on environmental data systems tends to be concentrated in a relatively limited number of countries, most of them developed. The nature of the problem, the increasing environmental concern and the need to respond to national and international regulations suggest that environmental data services will become a dynamic market.

170. The monitoring of ecological conditions and natural resources is often undertaken when a problem becomes obvious. Most environmental data are collected in response to, rather than in anticipation of, environmental problems and tend to be limited to a single environmental medium, such as water or land or the atmosphere, and tend to assess the impact of a specific activity or pollutant, frequently on a particular animal species.

171. Currently environmental data are collected independently by local, state, federal or national agencies to meet specific regulatory compliance needs, or in the context of individual research projects and/or national surveys or regional or global monitoring programmes such as GEMS, GRID or IRPTC, supported by international organizations like UNEP, WHO, WMO, IUCN, FAO, OECD and UNESCO.

172. The above shortcomings often result in lack of statistical rigor in the design and analysis of most environmental monitoring networks. Environmental management for sustainable development requires the continuous collection of a consistent set of data over long periods. In complex ecosystems changes occur slowly, and many of them result from cumulative impacts that can occur in different periods and have diverse origins.

173. The short-term, localized, single-agency, problem-specific and responsive approach tends to leave little useful comparable information with which to assess long-term environmental trends.

174. One international environmental data system is the International Register of Potentially Toxic Chemicals (IRPTC) created in 1976 by UNEP. Its main objective is to facilitate access to existing data on the production, distribution, release and disposal of chemicals and their effects on man and the environment. IRPTC collects and disseminates the information on chemicals in the form of Chemical Data Profiles, that is integrated data sets covering a broad spectrum of subject areas related to hazard identification and risk assessment of chemicals. The data is complemented with information concerning the management of industrial wastes and legal regulations concerning each product. IRPTC has more than 40,000 legal registers for more than 8,000 chemical substances for which there are legal regulations.

(l) ***Environmental law services***

175. Environmental policy and management must be supported by legal environmental principles, rules and mechanisms. Environmental topics present several problems for their translation into legal concepts. Environmental issues are complex and interact among themselves while evolving continuously. Many legal instruments have been evolved in response to specific local, national or international situations, resulting in the existence of complex institutional mechanisms comprising those legal rules that technically are known as "laws" and the proliferation of sectoral and incidental regulations intended for given situations, including treaties and other international agreements or specific sectoral regulations. Environmental legislation includes political constitutions, treaties, protocols and other international agreements, statutory edicts with force of law, regulations, technical standards, and others generally issued by national or local governments.

176. A frequent problem of existing environmental laws and regulations is their reactive and sectoral character, which means that they are inadequate to deal with problems that are systemic in nature and should be anticipated.

177. In this situation, the elaboration of environmental laws is very difficult, while expertise in the area of environmental law is extremely scarce, despite the fact that in developed countries environmental laws are increasingly enforced at different levels of government and with a much expanded array of tools.

178. Enterprises often consider compliance with environmental regulations as burdensome and costly, hence draining on profits. Laws and regulations are viewed as a threat to their competitive position or as obligations which involve restrictive legislation. The fact is that companies are often ignorant about environmental laws or consider evasion to be a fair game.

(m) ***Environmental education and training***

179. Environmental education and training have been a recurrent topic since the Conference on the Human Environment (Stockholm 1972), which recommended the establishment of an international programme on environmental education. Since then international conferences on such education have been held in Tbilisi, New Delhi and Moscow.

180. Environmental issues are permeating economic activities much more rapidly than people can be educated or trained in environmental issues. Most existing environmental education programmes are oriented towards primary and secondary

school levels and increasing environmental awareness among young people, while undergraduate programmes convey general knowledge on environmental science.

181. But environmental problems are expanding rapidly and are having to be solved today by a generation of professionals and technicians who have had little or no exposure to environmental matters during their education.[58] So managers, technicians and skilled workers have to integrate environmental considerations into their day-to-day tasks. They attempt to get environmental knowledge through specialized publications, conferences, seminars, correspondence courses, external training courses and internal training programmes. Industry incorporates environmental issues such as environmental management, environmental laws and regulations, waste management and treatment, pollution control, life cycle product assessment and analysis, risk assessment, eco-labelling, eco-marketing and so on in their "in-service" training activities in order to build up internal environmental capacities.

182. There is thus demand for environmental education and training activities of different types: environmental undergraduate studies, training for managers, engineers, economists, lawyers, and other professionals, and specific training for new environmental specialists.

183. Universities have an important role to play in environmental education and training, but until recently very few had curricula covering environmental issues. This is true also for matters such as pollution and waste treatment, which indeed should be part of normal engineering schools. An EPA report indicated that only 10 to 15 of the United States' almost 400 engineering schools include in their curricula courses on pollution prevention,[59] or waste management, treatment and minimization. Most of the universities that include this type of course are in developed countries such as the United States, Denmark, the Netherlands and Australia.

184. Few business schools provide either short, specialized and intensive courses on specific subjects or more lengthy and general courses on environmental management: in the United States only about 50 to 75 out of more than 700 business schools include this type of course. About 12 universities in Europe, nine in Canada, five in Asia and three in Latin America give some environmental training.

185. Business organizations such as the International Chamber of Commerce (ICC), acting through the Industry Advisory Group on Environmental Education and its Learning and Environmental Action Programme (LEAP), promote training on environmental matters. Other initiatives are being taken by international organizations such as the UNEP/UNESCO International Environment Education Programme, and UNEP training activities. ILO environmental training is mainly concerned with the working environment, safety and health and vocational training for employers' organizations, workers and trade unions.

V. ENVIRONMENTAL SERVICES IN DEVELOPING COUNTRIES

186. The environmental problematique in developing countries differs from that of developed countries. While in the latter the environmental problematique is basically related to the "quality" of life styles, in developing countries the basic problem is how to use the natural environment sustainably in order to accelerate economic growth and development: as long as basic human needs remain largely unmet, people in developing countries will tend to give lower priority to prevention of amenity damage.

187. Developing countries are encountering increasing environmental pressure from developed countries in relation to global environmental issues such as climate change, ozone depletion, the erosion of biodiversity and so on. Yet at the same time they have to solve dramatic environmental problems originating in the past exploitation of natural resources and from rapid urbanization and industrialization. These problems, although less fashionable for the North than global issues or the extinction of exotic species, are nevertheless more visible to local populations, who suffer them directly. Actually these problems are as

important as the global issues. For local populations who have never used CFC, who have no access to electricity, for whom the only energy available is from firewood or cow dung, and who have no access to drinking water or to basic health services, to give priority to global environmental problems for which they neither feel guilty nor assume any responsibility does not appear reasonable. Solving their immediate, local environmental problems has the highest priority.

188. Priorities vary among developing countries. For example in sub-Saharan Africa, contaminated drinking water and poor sanitation contribute to infectious and parasitic diseases that account for more than 62% of all deaths, twice the level of Latin America. On the other hand, rapidly industrializing countries encounter increasing industrial pollution and hazardous waste generation, which compound water and sewage problems and other environmental problems.

1. Rapid industrialization and the environment

189. Economically successful developing countries are encountering increasing environmental problems caused by rapid industrialization and uncontrolled urbanization associated with poor infrastructure and lenient environmental regulations.

190. This increasing pollution is associated with growing generation of complex toxic pollutants, including heavy metals, hazardous wastes and other forms of pollutants.

191. In Thailand, at the end of 1989 there were more than 51,500 small and medium-size industries, compared with 19,691 in 1979, of which 20,221 were causing water pollution, as against 5,393 in 1979. The number of factories generating potentially toxic wastes increased from 7,183 in 1979 to 17,057 in 1989. With current trends, the generation of these residues will triple over the next 12 years, and most of them are likely to be inadequately treated if treated at all. The Government has built a waste treatment unit for wastes originating in 200 medium and small electronic and electroplating factories in Bang Khuntien near Bangkok, and it is investing nearly US$ 40 million in the construction of three units for the treatment of toxic wastes in Ratchaburi, Chonburi and Saraburi.[60]

192. In the Republic of Korea there are 79,167 medium-size and small polluting industries (1991), of which 30,000 cause noise, 26,000 air pollution and 21,000 water pollution.[61]

193. Mexican sources of industrial pollution comprise about 1,261 factories generating waste water, of which nearly 1,100 are cited in the states of Guanajuato and Michoacán and the rest in the states of Querétaro and Jalisco. In the Lerma-Toluca corridor, 226 factories processing leather, petrochemicals, fertilizers, food, sugar, rubber, pulp and paper discharge wastes into the Lerma river, and agrochemical residues are added during the passage of the river through the states of Jalisco and Michoacán.[62]

194. Collective waste-water treatment systems have been developed in the industrial areas of Surabaya, Bikan and Karawauy in Indonesia. The industrial complex of Batam Island, which will receive the industries to be transferred from Singapore, includes units for the joint treatment of domestic and industrial wastes, which are also planned for industrial areas in Jakarta and Surabaya.[63]

195. Biological residues from the sugar, pulp and paper and rubber industries, agro-industry, intensive pig, poultry and cattle farming, and plantations are among the most polluting substances in developing countries. A large and rising amount of organic material is discharged untreated into rivers, depleting the oxygen content of the water and increasing the risk of them becoming anaerobic, with disastrous effects on the fish population, leading in some cases to their complete elimination.[64] In Thailand, while agro-industry expanded by 124% between 1980 and 1989, the demand for dissolved oxygen in water bodies increased by 111%; in the textile industry, the figures were 120% and 95% respectively.[65] On the basis of economic growth forecasts, and assuming a direct cause-and-effect

relationship between economic growth and generation of industrial residues, the biochemical oxygen demand (BOD) will multiply by four in the next 20 years, threatening the Thai freshwater system. China, Indonesia, México, Taiwan Province of China and many others face similar problems.

196. In Mexico the BOD of urban and industrial waste water is nearly 2,033,745 tons/year, of which the urban population accounts for 39% and industry for 61%. The larger discharges of waste-water in Mexico originate in: the sugar industry, with 38.8% of the total; the chemical industry, with 21%; oil, with 8.25% and pulp and paper, with 6.0%. The urban-industrial areas of México City, Guadalajara and Monterrey are responsible for nearly 40% of waste-water discharged and about 35% of the country's BOD.[66] The industry treatment capacity is equivalent to 25.3% of the total volume of waste-water generated. If these plants were functioning regularly, they would allow the elimination of 233,680 tons per year of the organic charge, meaning about 10.5% of the total organic charge generated in the country. Unfortunately, only 50% of them work regularly.

197. Pollution and waste disposal control in industrial areas such as export-processing zones are frequently poor. Most liquid wastes are discharged untreated into rivers, streams or other types of nearby water bodies, while solid wastes are dumped on land sites lacking minimum safeguards.

2. Hazardous wastes in developing countries

198. Hazardous waste is emerging as a serious problem in developing countries. Pollution of soil and groundwater by hazardous waste is growing in many industrialized cities such as Bombay where the Kalu river receives effluents containing heavy metals generated by more than 150 industrial units.[67] Bangkok, Cartagena de Indias, Alexandria, Guadalajara, Mexico City, Monterrey, São Paulo, etc., suffer similar problems.

199. The scarce and scattered information for developing countries indicates that the generation of hazardous waste in Singapore is about 28,000 tons per year, while in Malaysia it reaches 417,000 tons and in Thailand 220,000 tons.[68] Heavy metals and industrial effluents of tanneries, textile mills, chloro-alkali and sulfuric acid plants, and electroplating and electronic factories, together with organic material of the food industry, are dumped in the rivers passing through or near the cities of Kuala Lumpur, Petaling Jaya and Penang in Malaysia.

200. The large Egyptian industrial area located in Alexandria dumps effluents in lake Maryut and directly into the sea, so the coastal waters are polluted by heavy metals and agrochemicals, and the nearby Abu Kir Bay is heavily polluted by wastewaters from paper mills.

201. Similar cases are reported in Latin America. More than 300 tons of effluents with lead, cadmium and other heavy metals from more than 1,200 plants, plus 900 tons of sewage, are dumped daily in the Tiete river as it passes through São Paulo. In Durango, Mexico, groundwater pollution by arsenic, reported since 1940, has increased due to the over-exploitation of aquifers.

202. Few developing countries have adequate infrastructure to control the handling and disposal of hazardous waste, and in most of them no legislation or regulations dealing specifically with this type of waste have been enacted. Whenever legislation does exist, its enforcement is frequently poor because of the lack of infrastructure and economic and human resources.

203. Firms dealing with hazardous waste disposal are almost non-existent, without considering the fact that these firms must be subject to strict control and regulations, which are often missing. Until 1985 there were no regulations for the disposal of hazardous waste in Mexico City, while in India it was only after the Bhopal accident that stiff legislation was enacted to strengthen the regulation of the management, transport, treatment, and disposal of hazardous substances.

3. Urbanization and the environment

204. Urban environmental problems are likely to increase dramatically in developing countries. It must be noted that while in 1930 only one of the world's largest cities was in a developing country (Buenos Aires), by the end of the present decade eight of the expected 10 largest cities of the world will be in developing countries. They will be: Mexico City, with an estimated population of 31 million; São Paulo, with nearly 26 million; Shanghai, with more than 22 million; Beijing and Rio de Janeiro, with about 20 million each; and Bombay, Calcutta and Jakarta, each of them with a projected population of 17 million. In addition, more than 40 cities in developing countries will have a population in excess of 5 million, among them Lagos, Manila, Bangkok, Cairo and Santiago. In this perspective the environmental problems associated with inadequate housing, poor sanitation conditions, lack of drinking water, urban air pollution, municipal waste disposal and so on are likely to increase.

(a) *Urban air pollution*

205. Air pollution is particularly serious in several cities such as Mexico City, Santiago de Chile, Taipei, Bombay or Bangkok. According to WHO, more than 1.2 billion people reside in urban areas in developing countries exposed to levels of dust and smoke (suspended particulate matter-SPM) that exceed recommended WHO standards, resulting in severe respiratory problems, aggravated by poor health and nutrition levels. It has been estimated that if the levels of SPM were brought down to the annual average level recommended by WHO, between 300,000 and 700,000 premature deaths could be averted. High levels of SPM affect labour productivity, for as many as 2.1 working days a year are lost to respiratory illness for every adult in the labour force.

206. Studies carried out in Latin America conclude that air pollution levels are so high that urgent control is required in São Paulo, Rio de Janeiro, Belo Horizonte, Santiago, Bogotá, Mexico City, Monterrey, Guadalajara, Caracas and Lima-Callao.[69]

207. Increasing road traffic, and particularly emissions from vehicles, is the main source of nitrogen oxides and lead in urban areas. In Thailand, transport is the origin for 33% of CO_2 emissions, 20% of SPM and 17% of SO_2. With the present trends in the transport sector, it is estimated that, from now to the year 2000, the emission of the main air-polluting gases will increase by between 25 and 30% in Seoul, between 150% and 165% in Bangkok and between 300% and 330% in Jakarta.

208. The presence of lead in the air is greatest where leaded gasoline is used. Although in some developing countries the lead content in gasoline has been limited or prohibited altogether, in most of them leaded gasoline is used: while 93% and 96% of the gasoline marketed in Thailand and Malaysia respectively is leaded, the figure in Australia is 64%, in Hong Kong 62%, in the United Kingdom 59%, in Singapore 56% and in Norway 53%.[70] In 1970 the lead concentration level in the atmosphere in Mexico City was 5.1 mg/m^3, compared with 2.5 mg/m^3 in Los Angeles or New York. By 1980 the level had been reduced to 3.6 mg/m^3 and in 1987 to 1.5 mg/m^3 thanks to the use of unleaded gasoline.[71] In Brazil the widespread use of an alcohol-gasoline mixture has led to a considerable reduction of air pollution.[72] Nearly 30,000 factories account for 13% of air pollution emissions in the metropolitan area of Mexico City (ZMCM) and for 37.9% of emissions of SO_2.[73]

209. There are also environmental problems specific to some developing countries. For example, between 400 and 700 million people, particularly women and children, are affected by indoor air pollution created by inside burning of charcoal, wood and dung, especially in rural Africa and South Asia.[74]

(b) *Solid urban waste management in developing countries*

210. A very visible effect of expanding urbanization is the appearance of uncontrolled dump sites all around cities and, due to rapid urbanization, within

cities. In most cities, squatter settlements are usually not served by garbage collection services, so urban solid wastes accumulate in the streets. The Egyptian case illustrates the magnitude of the problem: urban solid waste is already accumulating along the banks of the Nile delta, and forecasts show that its generation will reach 16,900 tons daily by the year 2000, requiring nearly 6,200 ha of land for landfill purposes and 9,680 ha per year in the year 2025.[75]

211. In 1991 in the greater urban area of Algiers, solid waste generation was calculated at 2,640 ton per day. In Tunis, the figure was 900 tons per day, with a projected figure of 1,560 tons by the end of the decade.[76]

212. Less than 10% of urban waste is treated, and only a small fraction of that treatment meets acceptable standards. Given present trends, by the end of the decade over 2 billion people will lack basic sanitation, and about half the urban population in developing countries will lack adequate waste disposal. Waste problems differ greatly from one case to another, with differences based on the quantity and type of waste produced, the method of collection and disposal, and regulations.

213. A World Bank report[77] noted that, while a citizen of a low-income developing country produces around 0.5 kg per person per day of waste and a middle-income country generates between 0.5 kg and 0.9 kg of waste per person per day, a developed country generates between 0.7 kg and 1.8 kg per capita daily. At the same time, while the relative moisture of waste in developing countries ranges between 40 and 80%, in developed countries it is only between 20 and 30%; this means that the weight of waste in a low-income developing country is between 450 and 500kg/m^3, in a middle-income country it fluctuates between 170 and 330kg/m^3 and in an industrialized country it is between 100 and 170kg/m^3. This is due to the composition of wastes; while in a low-income country organic material may represent between 40 and 85% of total waste, in a middle-income country it is between 20 and 65% and in a developed country from 20 to 50%. This aspect has important implications for urban solid waste management.

214. In 1988 Mexico generated about 21,246,275 tons of urban solid wastes, meaning nearly 260 kg per capita per year and 57,935 tons daily. The daily collection capacity was about 40,554 tons, so 14,802,392 tons per year, i.e. 70% of municipal waste generated, was collected; however only 45% was disposed of in registered sites. By the end of the 1980s there were in Mexico five plants for the treatment and recovery of municipal garbage, with a capacity of 2,070 tons per day.[78]

215. Manila, with a population of 7 million, generates 3,500 tons of solid waste daily, of which 70% is collected, and in Cairo 15% of garbage is never collected. Urban wastes have been managed in developing countries by traditional systems which in fact constitute, in some cases, an important "informal sector", as is the case in Dakar. However, the methods used, as well as the increasing magnitude of disposal, has moved Governments to implement new, more systematic and modern approaches.

216. The management of urban solid waste in Cairo has been a traditional service provided by the *zebbelin*, who are private garbage collectors with donkey carts. The system is administrated by a contractor, *wahi*, to whom the *zebbelin* subcontract the service for specific routes. They are paid for the service by the customers of the route they serve. Together with the right to collect the garbage, the *zebbelin* also acquire the right to recycle it. The *Zebbelin* live in well defined areas, on the outskirts of Cairo near the Muqattam Hills, where the collected garbage is taken. The method used to separate recyclable materials consists in dumping the garbage in the street, where the whole family walks through and sorts the garbage by hand.

217. In 1986 the governorate of Cairo invited tenders for garbage collection from private companies, arguing the unhygienic method of the *zebbelin*. Facing the risk of loosing their monopoly, the *zebbelin* and the *wahi* created their own private company, the Environmental Protection Company, which won the contract for garbage collection in Zamalek and Manial using motorized vehicles and based

on the same traditional arrangement between the *zebbelin* and the *wahi*.

218. The Government of Viet Nam created a special enterprise, URENCO, to manage urban solid waste in Hanoi. This enterprise employs 3,000 persons operating a fleet of more than 200 vehicles of different types for the collection, cleaning and treatment of urban wastes. However, this fleet is not only rather obsolete but, due to economic restrictions and the consequent difficulties in obtaining spare parts, operates at only 75% of its theoretical capacity. Moreover, in the narrow streets of the old city, garbage is collected by hand with wheelbarrows directly from houses or the sidewalk where it is dumped. The cost for collection is 500 dong[79] per month, which will be increased to 1,000 dong in 1995/96. URENCO provides services to nearly 80% of the Hanoi metropolitan area, but it collects only two-thirds urban residues generated. Nearly 52% of waste is organic, compared with 16% in Paris and 35% in Hong Kong, the paper component is only 2.7%, while in Paris it represents almost 41%, in Vienna 34% and in Hong Kong 21%, and the share of glass is 0.5%, while in Paris it is almost 10% and in Hong Kong 3%. The total volume of waste (collected) in Hanoi is 361,000 tons, of which 54,750 tons are industrial or generated in hospitals not receiving any treatment. It is estimated that this volume will double by the end of 1996. The mixing of household wastes with potentially toxic wastes from industry and those of hospitals creates serious risks for the population, polluting groundwater and reaching, finally, the main rivers such as the Red River. The large organic component suggested a compositioning process for the production of fertilizers in order to replace imported nitrogenous fertilizers. A US$ 800,000 plant built with resources provided by UNDP produces 7,500 tons of organic fertilizer from 30,000m³ of solid waste per year, representing only 3% of the total urban solid wastes of Hanoi. Fertilizer is sold at 4.8 dong per kilo which is much lower than the cost of production: 8.8 dong per kilo. The current average cost for urban solid waste management in Hanoi is about US$ 2 per ton.

(c) *Urban water and waste-water*

219. Waste-water management and sanitation are pressing environmental problems. The main sources of water pollution are sewage, industrial effluents (see V.1) and storm and urban run-off in the cities, while in rural areas agricultural run-off is probably the most important.

220. The large majority of cities of one million inhabitants or less in Africa and Asia have no sewerage system at all, and human and household wastes are dumped untreated in rivers, streams, ditches, etc. When a sewage disposal system exists, it frequently serves only the rich residential areas. In India there are 3,119 cities, of which only 8 have full sewerage and sewage treatment facilities and only 209 have partial facilities. In Calcutta the sewerage system is restricted to a third of the urban area, with about 5.5 million people living in unserviced areas. Similarly drinking water is piped only to the centre of the city and the residential areas. In Madras the sewerage service covers 31% of the city, and raw sewage thus flows freely into the watercourses near the city; only 2 million of the 3.7 million residents of Madras are connected to the local water supply system, and the rest of the urban population must rely on public taps or wells if outside the service area.

221. Each day the Yamuna river receives 200 million liters of Delhi's untreated sewage. The untreated sewage of 114 cities of more than 50,000 inhabitants is dumped in the Ganges, in addition to industrial waste water (see V.2). Calcutta's raw sewage is continuously dumped from 361 outfalls into the Hooghly estuary, together with untreated industrial waste.[80]

222. Karachi's untreated effluents, industrial and urban wastes are discharged into the river Lyari, and only one third of households have piped water connections while the rest use public standpoints or buy water from vendors.

223. In Bangkok only 2% of the population is connected to a sewer system; human waste is disposed of through septic tanks and cesspools, and waste water is generally discharged into stormwater drains and canals. In Jakarta there is no sewerage system, and septic tanks serve nearly 25% of the population, while the

rest use cesspools, pit latrines or ditches. In addition, less than 25% of the population is connected to piped water systems, and 30% buy water from vendors.

224. In Shanghai, only a few houses have flush toilets, and less than 5% of the sewage, mostly of industrial origin, is treated. The Suzhou Creek and the Huangpu river receive near 3.4 million cubic meters per annum of industrial and domestic wastes.[81]

225. The situation tends to be worse in many African countries. Only five cities in Senegal have sewerage systems, there is no system at all in Kinshasa, and in Khartum the existing system serves only 5% of the urban area. The supply of water is also at fault in most African cities: in Dakar, 28% of the houses have private water connections, 68% must use public standpipes and the rest have to buy from carriers. In Kinshasa, while the residential areas are covered by a piped water network, only 20% of the poor sectors are connected to it.

226. Bacterial contamination of Tunisia's coastal waters is attributed to sewage effluents which, although treated to a secondary biological stage, are discharged into nearby drainage courses, from where they accumulate at the shore.[82]

227. The Umum canal in Egypt carries nearly six million cubic meters per day of drainage waters polluted with domestic and industrial wastes, as well as agrochemicals collected from a large area starting in Cairo.

228. In Colombia, untreated sewage is dumped in the Tunejuelito river. São Paulo has only five sewage treatment plants that can treat only 12.5% of the sewage generated. In Mexico there are 361 waste-water treatment plants with a capacity of 25.10m^3/sec and 282 industrial waste-water treatment plants with a capacity of 20 m^3/sec; this means that the country's capacity is about 24% of the total volume of municipal waste water, estimated at 105 m^3/sec.[83]

4. Laws and regulations

229. Most developing countries lack regulatory, legal and institutional mechanisms to deal with environmental problems. Where they do exist, often they are not enforced either for administrative, economic or political reasons or simply because of lack of trained inspectors. Besides, standards and methods are frequently inappropriate because they are modelled on those of developed countries without any consideration of local socio-economic conditions or environmental and cultural characteristics.

230. In some countries, although environmental regulations do exist, the administrative structures and mechanisms necessary for their enforcement are missing or do not operate. Frequently the problem is further complicated by the existence of a legal pluralism which implies the coexistence of modern legislation with customary or traditional laws.

231. Licensing requirements for new industries and site locations rarely include environmental impact assessment studies. In Colombia, sections 27 and 28 of the Code on Renewable Natural Resources and Protection of the Environment call for the preparation of EIA documents for any activity likely to produce environmental damage. In Malaysia, a prospective investor must first of all identify whether the proposed venture is categorized by the Government as a "prescribed activity", in which case he has to submit a report on EIA to the Director General of Environmental Quality. For an industrial project, the EIA would assist in determining the site suitability, as well as the necessary environmental control measures. The Government has published a "Handbook of EIA Guidelines" in order to help project proponents understand the objectives, procedures for carrying out EIA, studies and guidelines on the preparation of EIA reports.

232. The Environmental Quality Act of Malaysia specifies more than 60 "prescribed activities" in different sectors ranging from agriculture and industry to waste treatment disposal, power generation and recreational development.

233. In other countries, EIA studies are not specifically required, but firms have to observe strict environmental regulations and adopt specific practices and environmental management routines. For example, the Environment Preservation Law of the Republic of Korea establishes a series of responsibilities for industries such as the regular monitoring of their emission of pollutants and effluent and the submission of reports to authorities.

234. In Mexico there is a Federal Governmental Law, the General Law for Ecological Balance and Environmental Protection, as well as Six Federal Regulations concerning: EIA, air pollution, dangerous wastes, water pollution, pollution from mobile sources in the DFM and noise pollution. In addition there are more than 150 standards dealing with water and air pollution, etc. Finally 16 states have their own environmental law. The consequence of this complex legislation is obviously an increasing demand for environmental equipment, technologies and environmental services.

235. Any firm wishing to establish a facility in Mexico has to provide for environmental compliance from the very initial planning phase: an environmental impact statement is required before any facilities can be constructed or expanded. To minimize risks, when setting up in Mexico foreign firms need to hire an environmental and legal consulting firm with knowledge about Mexican regulations. The Mexican authorities consider EIA as one of the most useful instruments for the implementation of environmental law, and projects in specific sectors or areas must provide a document named Environmental Impact Declaration. The preparation of EIAs has shown a sharp increase: between 1983 and 1988, the former Department of Urban Development and Environment (SEDUE) received 377 projects incorporating EIAs, while in 1989 the figure was 259 and in 1990 it was 535, with an estimated figure of more than 2,000 for the period 1991-1994.

236. In Colombia and Thailand, EIA systems have been laid down by specific legislative enactments; for example in Thailand, the Improvement and Conservation of National Environmental Quality Act of 1975 (NEQA/75) establishes that a project proponent or licensing agency must consult with the National Environment Board.

237. In addition to the preparation of EIA, several countries have additional regulations which require specialized professionals. For example, the Mexican law makes a risk assessment study obligatory for those activities considered as having a high risk or as being dangerous, among them those related to the manipulation, processing, transport and use of toxic materials. In the period 1989-1990, SEDUE revised 209 projects incorporating a risk assessment study.

238. The most important legal services needed by developing countries seem to relate to the design of national environmental laws; sectoral environmental legislation in such areas as air and water pollution, noise, and the working environment; conservation laws; regulations concerning economic activities; definition of standards; etc. Technical assistance is also needed in relation to the existing international regulations and conventions. Finally there is a demand for the preparation of rules and criteria to orient environmental measures and instruments like EIA, eco-taxes or eco-labelling.

239. In addition to Governments, the private sector, and in particular the manufacturing, agricultural and export sectors, need legal services in order to help them comply with national and international environmental regulations.

240. The growing environmental concern in developing countries and the environmental requirements that are more and more frequently set by financial institutions have moved some developing countries to request services from certain organizations that originally were not supposed to supply such services. Thus the World Conservation Union (IUCN), formally known as the International Union for the Conservation of Nature and Natural Resources, provides pre-funded EIA support services for the Governments of developing countries. These services include the various aspects of EIA from initiation through implementation, including the scope and preparation of terms of reference, preliminary assessment, project management, communications, review and evaluation of drafts

and final reports, institutional development, strengthening national capabilities and training, preparation of guidelines and EIA regulations.

241. It has been noted that a higher proportion of industrial accidents occur in small and informal enterprises. This is due not only to the absence of regulations but also to the difficulties for Governments in monitoring and enforcing compliance with environmental, health and safety regulations, among other things because of lack of trained staff. Although data are scarce, it seems interesting to note that the Government of Thailand has 700 people for the control of emissions and waste discharge by the nearly 51,500 industrial units; however the Industrial Environment Division, directly responsible for the control of anti-pollution regulations, only employs 143.

5. Other environmental services in developing countries

242. Environmental monitoring and data collection are still scarce in developed countries and certainly in developing countries, creating serious problems for the design and implementation of environmental policies. Very little environmental monitoring is at present conducted in developing countries, and environmental data collection in different countries is neither comprehensive, coordinated nor long-term.

243. A second environmental service deserving attention concerns education and training at all levels. Scarcity of trained personnel affects all countries, but developing countries in particular.

VI. CONCLUSIONS

244. This report is a first attempt to identify and classify environmental services. Further work will be necessary to explore and assess their contribution to employment generation and new investment opportunities, economic efficiency, productivity, and competitiveness. For this it will be necessary to identify, for each sector and in each national economy, which are the strategic, current and potential environment-related services, either by virtue of their contribution to the performance of other sectors or by virtue of their direct contribution to national welfare, economic growth and sustainable development.

245. Each of the 13 categories or types of services identified deserves broader and more in-depth analysis. Some of them are mainly national in character, while others seem to have relevance for international economic relations and flows, though there is no clear indication about their contribution to trade, foreign direct investment, and the like. In this context it seems necessary to explore in detail how national and international regulations relate to the expansion of the environmental service sector. This is particularly important for some of the services identified, for example those related to insurance and the international movements of wastes, particularly toxic wastes. Environmental accidents are of greater social impact in developing countries than in developed countries, for the effects are not confined to the industry concerned and its immediate surroundings but tend to spread to human settlements nearby. Bhopal is a clear example. The economic magnitude of these accidents is underestimated because of the defective insurance systems in developing countries.

246. This brief description of the different environmental services suggests the extensive presence of large TNCs and of international movements of capital, human skills and investment, for which information is almost non-existent.

247. For developing countries, it is important to identify new environment-related services because, inter alia:

(a) Increasing environmental degradation requires new skills, practices, technologies and methodologies that very often are not domestically available;

(b) New services are needed for the sustainable use of natural and environmental resources;

(c) Services are needed in order to comply with new international environmental regulations;

(d) Services related to the environment can generate new jobs and export-oriented activities;

(e) New environment-related services can contribute to increased productivity and competitiveness in the primary and export-oriented sectors;

(f) Efforts are required to save scarce foreign currencies that otherwise may be spent in hiring foreign services to deal with domestic environment-related problems.

248. During recent decades, the environmental problematique has been widely examined, but the economic implications are still scarcely understood. Environmental services illustrate a rather unknown dimension of the environmental phenomenon, which certainly will require more in-depth analysis and work.

Endnotes

1. A poll done in the United States shows that 97% of consumers consider the environment as their top or near top priority in assessing a corporation's social responsibility. For their part 85% of the people of the European Union (EU) believe that environmental protection is an urgent and immediate problem and 69% are of the opinion that economic development should be achieved in harmony with environmental protection. European Union, "Eurobaromètre -Dernières tendances de l'opinion publique", Le Courrier, No. 137, Janvier-Fevrier 1993.

2. Research undertaken by the University of Munster (Germany) notes that although 58% of the firms declared that they had adopted the approach in question, only 20% have in reality included environmental objectives in their strategies, policies, and managerial practices.

3. As a consequence of the United States' Clean Air Act, Clean Water Act and Safe Drinking Water Act, it is estimated that industry will spend US$ 20 billion by the year 2000 on improved air-pollution-control systems, while the demand for waste-water treatment technologies is likely to grow by more than US$ 100 million per year.

4. John Hunt, "Wide implications for business, industry and the environment 2", Financial Times, 21 April 1989.

5. OECD, "The OECD Environment Industry: Situation, Prospects and Governments' Policies", OCDE/GD(92)1, Paris.

6. A survey in the United States shows that over 80% of consumers indicate that a product certification scheme affects their purchasing decisions.

7. Other existing eco-labels are: the Nordic White Swan, the Japanese EcoMark, the American Scientific Certification and Green Seal, the Canadian EcoLogo, etc.

8. John Elkington & Julia Hailes, Green Consumer Guide, Victor Gollancz, London, 1988.

9. Between November 1988 and May 1989, the proportion of respondents who chose their products because of their environmental soundness increased from 19% to 42%, while the British weekly rate of conversion of cars to unleaded petrol rose from 200 to 6,000. Loblaws led the Canadian food retailing industry in launching a C$ 10 million green products initiative and in 1989 introduced 1,900 green products, most of them imported from Europe.

10. This competitive aspect is revealed by some examples: IBM indicates that the environmental issue is a motivation for "being ahead", and Shell refers to the "leadership role", as does British Telecom.

11. The chief executive of Monsanto, Mr. Richmond Mahoney, has stated: "Our job is to do it our way, before we have a sword hanging over our heads." "Cleaning up: A survey of industry and the environment", The Economist, 8 September 1990.

12. By the middle of the 1980s, German firms were offering cars running on unleaded petrol and fitted with catalytic converters to reduce factors leading to smog and acid rain problems without lessening their performance. BMW press advertising was promising that each of its cars, whether it cost US$ 20,000 or US$120,000, "will run just as well on unleaded fuel as it does on leaded. Without taking so much as an extra millisecond to reach 60 mph. Or an extra milliliter of fuel to get there."

13. Chemical Firms like DuPont, Monsanto, Dow, ICI, Ciba-Geigy and Bayer consider the environment as one of the three or four most important issues facing their industry. See "Cleaning up: A survey of industry and the environment", The Economist, 8 September 1990. In 1990 Bayer spent 20% of its manufacturing

costs on environmental protection and ICI estimated that 25% of the capital cost of new plants can be taken up by environmental protection.

14. Among the larger firms are: Alfa Laval, Bilfinger and Berger, Thyssen or Hitachi for water treatment equipment; in equipment for air pollution control the names are: Mitsubishi, Hitachi, Lurgi, General Electric; finally Browing Ferris and Hoechst are among the larger producers of waste treatment equipment.

15. Research by the IFO Institute for the regions of North Rhenania-Westfalia, Saxony and Berlin identified 2,800 firms, excluding municipal constructors, chemical and commercial firms, actively involved in the environmental market.

16. The largest are: Waste Management Inc., Browing-Ferris Industries Inc; Zurn Industries; Roy F. Weston, Riedel Environmental Services, Canonie Environmental Services, Davis Ware and Waste, Calgon Carbon, etc.

17. P. Bifani, "Environmental technology for developing countries", in K. Curi (ed), Appropriate Waste Management for Developing Countries, Plemnum Press, New York and London, 1982.

18. Ibid.

19. R. Malaman, S. Paba, L'Industria Verde, Il Mulino, Bologna, 1993.

20. R. Hueting, (a) New Scarcity and Economic Growth, North-Holland Publishing Co., Amsterdam-New York-Oxford, 1980; (b).... et al, Methodology for the Calculation of Sustainable National Income, A WWF International Publication, 1992.

21. For example, in the United States, the EPA provides up to 55% of the funding for municipalities to build treatment facilities necessary to meet water quality goals.

22. For example eco-labelling places on Governments the responsibility to provide reliable information about the environmental performance of products so that consumers can make adequate decisions. For this Governments have to set up competent bodies for the definition of criteria and the awarding of the eco-labels, to gather information from manufacturers, to monitor its adequacy and to undertake the technical testing concerning products, processes and packaging in relation to previous established criteria and standards. So to set eco-labelling schemes will require a gamut of services in all phases of design, implementation and monitoring.

23. In Canada and the Netherlands, independent review panels issue guidelines for the preparation of each specific EIA document and review them once they have been prepared.

24. However the Directive does not require that the borrower submit an EIA document; it only requires that the borrower should submit the final EIA report to the bank prior to Bank appraisal. The directive lacks the formality and mandatory nature compelling borrower countries to adapt EIA procedures, and does not expressly apply to sectoral and structural adjustment programmes, which are the Bank's most important activities. World Bank "Operational Directive 4.00", Annex A: Environmental Assessment, 1989.

25. UNEP, "Environmental policies and practices of the financial services sector", 1995.

26. An executive of DuPont has stated: "One alternative to recycling waste ourselves is to form relations with other companies: we won't lose responsibility for the waste, but they will help us to handle it". "Cleaning up...", The Economist, 8 September 1990.

27. Environmental Business Journal, December 1992.

28. For example, the desulphurization of the ENEL Italian thermal plants was done by a pool of several firms: the Swedish Fläkt, with technologies licensed from Deutsche Babcock, was responsible for the technical aspects; Belleli was entrusted with construction and equipment; SACMA was responsible for the chemical reagent and the transport of ashes; SMOGLESS did the sludge management; and ITALIMPIANTI did the general coordination and the basic engineering and management of the project.

29. United Nations, "Provisional Central Product Classification", Satistical Papers ST/ESA/STAT/SER.M/77, United Nations, New York.

30. In France these firms are associated with Syntec-Ingénierie of the Chambre des ingénieurs française.

31. See Environmental Business Journal, San Diego, California, April 1992; EPA, "Environmental Investments: the Cost of Clean Environment", Report of the EPA Administration, 1990; Miller & Associates, Environmental Markets, Norcross, Georgia, 1992-1995; J. Berkovitz, "Outlook of the industry", The Environmental Forum, Jan-Feb 1992.

32. P. Bifani, (a) Desarrollo y Medio Ambiente, MOPU Madrid, 1984; and (b) "Environmental technology for developing countries"; in K. Curi, (ed.), Appropriate Waste Management for Developing Countries, Plenum Press, New York and London, 1982.

33. OECD, The State of the Environment, Paris, 1991.

34. United Nations, "Provisional Central Product Classification", Statistical Papers ST/ESA/STAT/SER.M/77, United Nations, New York.

35. Ibid.

36. OECD, The State of the Environment, Paris, 1991.

37. Victoria J. Tschinkel, "The Rise and Fall of Environmental Expertise", in J.H. Ausubel and Hedy E. Sladovich (eds.), Technoloy and Environment, National Academy Press, Washington, D.C., 1989.

38. Harvey Yakowitz, "What trade in recoverable wastes?", The OECD Observer, No. 180, February/March 1993 (pages 26-28).

39. Ibid..

40. US Office of Technology Assessment, Serious Reduction of Hazardous Waste, For Pollution Prevention and Industrial Efficiency, Government Printing Office, Washington, D.C., 1986.

41. OECD, op.cit..

42. The OECD has estimated that the cost of landfill for asbestos, a serious hazardous waste, has increased almost 10 times in Western Europe.

43. B. Kwiatkoska and A.H.A. Soons, Transboundary Movements and Disposal of Hazardous Waste in International Law: Basic Documents, Martinus Nijhoff, 1993.

44. This is the case of petrol stations. In the United States, 200,000 storage tanks for gasoline are thought to be leaking.

45. UNEP "Managing contaminated land", Industry and Environment, Vol.16, No.3, July-September 1993, Paris.

46. ECOTEC Research and Consultancy Limited, The Impact of Environmental Management on Skills and Jobs, Birmingham, 1990.

47. United Nations, Provisional Central Product Classification.

48. Lyonnaise des Eaux-Dumez, Annual report 1993, Nanterre, France.

49. EPA, Business Opportunities of the New Clean Air Act, Washington, 1992.

50. United Nations, op. cit.

51. United Nations, op. cit.

52. UNEP, "Environmental auditing", Industry and Environment, Vol. 11, N° 4, October-December 1988.

53. This was one reason why, after the Exxon Valdez accident, Shell announced that it will no longer ship oil to many American ports.

54. Elkington and Hailes, op.cit.

55. HMIP's 3rd Report of April 1991, quoted by The Economist, 8 September 1990.

56. United Nations, op.cit.

57. Rhône Poulenc has a computerized waste-accounting system allowing it to keep track of all waste generated at every plant, to cost their management and disposal and to control them. The agrochemical group Ferruzzi has drawn up a balance of its net carbon-dioxide emissions.

58. It has been reported that 60% of environmental managers working in British companies had no environmental content in their basic qualifications. UNEP, "Education and training", Industry and Environment, Vol 16, No. 4, Paris, 1993.

59. D. Allen, "Survey of Pollution Prevention Education in US Engineering Schools", Report of the Pollution Prevention Focus Group, Pollution Prevention Education and Training Committee, EPA National Advisory Council for Environmental Policy and Technology, US Government, Printing Office, Washington, D.C., 1992.

60. David O'Connor, La gestion de l' environnement dans les pays en voie d'industrialisation rapide: leçons tirées de l'Asie de l'Est, OECD, Paris, 1994.

61. Ibid.

62. Secretaria de Desarollo Social, Instituto Nacional de Ecologia, México: "Informe de la situacion general en materia de equilibrio ecologico y proteccion al ambiente, 1993-1994", 1994.

63. O'Connor, op. cit.

64. This was, in the 1970s, the case of the river Mae Klong in Thailand, as a result of which the Government invested US$ 1 million in the Mae Klong Central Waste Treatment Facility for the treatment of all molasses produced by the sugar mills of the area.

65. D. O'Connor, op.cit.

66. SEDUE, "Estudio de evaluación de cuencas hidrológicas del pais en cuanto a su grado de contaminación", Subsecreatria de ecologia, Dirección general de prevención y contaminación ambiental, México D.F., 1985.

67. Centre for Science and Environment, The State of India's Environment 1982: a Citizen Report, Delhi, 1982.

68. F.A. Uriarte, "Hazardous waste management", in ASEAN, Hazardous Waste Management (eds. S.P. Maltezon et al), Tycooly, London, 1989.

69. I. Romieu et al, "Urban air pollution in Latin America and the Caribbean: health perspectives", World health statistics quarterly 23 (2)153-157, 1990.

70. CONCAWE, Motor vehicle emission regulations and fuel specifications 1992, Brussels, 1992.

71. SEDUE, "Contaminación atmosférica, zonas metropolitanas, ciudad de Mexico", Secretaria de Desarrollo Urbano y Ecologia, México, 1981, 1987.

72. WHO, Our Planet, Our Health - report of the WHO Commission on Health and the Environment, Geneva, 1992.

73. SEDUE, op. cit.

74. WHO, op.cit.

75. World Bank/European Investment Bank, "The Urban Environment in the Mediterranean", Working Paper # 3, November 1991.

6. Ibid.

77. Sandra J. Cointreau, Environmental Management of Urban Solid Wastes in Developing Countries, The World Bank, Washington D.C., 1982.

78. Secretaria de Desarrollo Social, Instituto Nacional de Ecologia, 1994, op.cit.

79. 11,000 dong = US$ 1.

80. Centre for Science and Environment, The state of India's environment 1982: a citizen report, Delhi, 1982.

81. K.C. Sivaramakrishnan and L. Green, Metropolitan management - the Asian experience, The World Bank, Oxford University Press, Oxford, 1986.

82. World Bank-European Investment Bank, "The urban environment in the Mediterranean, Environmental programme for the Mediterranean", Working paper #3, 1991.

83. SEDUE, op.cit., Secretaria de Desarrollo Social, op.cit.